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Comparisons of alternative methods of teaching plant material identification in selected schools of Iowa

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Comparisons of alternative methods of teaching
plant material identification in
selected schools of Iowa

by

Duane Allen Kaas

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
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INTRODUCTION

The popularity of ornamental horticulture in high school vocational agriculture programs in Iowa has reached a point where 31 out of the 245 vocational agriculture departments now offer at least nine weeks of instruction in some phase of horticulture. An additional 11 departments offer a full semester or a full year of horticulture as part of their program. Each year, more departments are adding to their curriculum, units of instruction in horticulture for the secondary school student, varying in length from two to 18 weeks.

It becomes a concern to these departments as to what should be included in their curriculum offering dealing with ornamental horticulture. Many of the vocational agriculture instructors in Iowa feel they lack training and an adequate background in horticulture to successfully implement such a program into their school. Bass (2) reported that 22 agricultural education and ornamental horticulture specialists unanimously agreed that high school ornamental horticulture courses should include floriculture, landscape management, nursery management, and turf management. The breadth and depth at which these topics would be covered will vary with the knowledge of the instructor.

A second area of concern for an instructor of ornamental horticulture is identifying and teaching competencies and skills needed for job entry into horticultural occupations. Studies, such as those conducted by Virta (62), have been instrumental in identifying essential competencies required of workers in the ornamental horticulture industries. A similar study conducted by Johnson (22) ranked competencies according to level of

importance as assigned to them by horticultural enterprises in Texas.

From highest degree of importance to lowest, they are:

1. Identify ornamental plants
2. Work relations
3. Nursery crop production
4. Controlling plant insects and diseases
5. Merchandising horticultural plants and supplies
6. Plant growing media
7. Constructing, maintaining, and using plant growing structures
8. Propagating horticultural plants
9. Arboriculture
10. Operating, repairing, and maintaining small power and other tools and equipment
11. Establishing and caring for lawns and turfs
12. Floral crop production
13. Water systems and plumbing
14. Developing the landscape design or plan
15. Small building construction
16. Electricity
17. Floral design

When Webb and Johnson (64) interviewed horticulture employers in Texas, one nurseryman reported that learning to identify and pronounce names of the most popular horticultural plants was one of the top three important competencies to be mastered by his employees.

In 1968, Shry (53) determined the competencies needed by ornamental horticulture graduates of Maryland high schools to become gainfully employed in the horticulture industry. The results of this study indicated that Maryland nurserymen felt that employees should have a comprehensive training in the following: scientific and common names of plants; propagation by cuttings, seeds, and budding; identification of plant insects and diseases; forcing plants to bloom; and selecting plants for a flower bed.

This author also found that high priority was placed on the ability of workers to identify and categorize plant material by employers and employees alike in studies conducted in Iowa and Wisconsin (25,24). Horticulture businesses in Wisconsin were asked to rate the degree to which they felt their employees should possess the skills and knowledges listed by the researcher. Of the five most important competencies identified, two dealt with plant characteristics and identification. These competencies were of particular importance to the nursery industry and arborist service.

Employees of various horticulture industries in Iowa were asked to respond to a list of competencies as to the frequency at which these competencies were performed by them. The scale used to measure frequency of performance was as follows: 5-daily, 4-once a week, 3-once a month, 2-once a year, and 1-never. Employees from three horticulture industries in Iowa, arborist service, greenhouse production, and retail florist, reported mean values of 3.2 or greater for the frequency at which they were responsible for identifying plant material in the performance of their work.

Wotowiec and Woodin (65) found that the knowledge and skills needed by employees in each of the business areas varied to some extent, but some fundamental understandings are important to most employees. For example, the most necessary areas of knowledge for employees of garden equipment and supply dealers were found to be control of insects and disease problems, and the identification of woody and herbaceous plant material.

Through review of previous studies involving competencies needed by workers in horticultural occupations, it becomes apparent that one leading skill designated as being highly important by employers and employees alike is the ability to recognize and identify plant material. Thus, it seems logical that this competency receive high priority among those skills and knowledges taught to students in secondary and postsecondary horticulture programs.

It now becomes the task of the vocational agriculture instructor to determine the most effective and efficient method of teaching concepts about plant identification. As Muzio et al. (41) pointed out, during the past decade, a number of educators have examined new and different learning and teaching approaches. This interest has been stimulated by a variety of factors, among them:

1. changes in student population, particularly with a larger number of students who are more exposed to multimedia communications and who have difficulty in reading, writing, and language skills,
2. needs for a more flexible educational system in response to changing demands of society,
3. desire by some educators to explore new methods that might assist them in being more effective in their instruction,
4. continued development of knowledge in academic and vocational disciplines, coupled with developments in multimedia technology, and
5. soaring educational costs, especially in vocational programs involving laboratory equipment and materials.

The last factor represents a major obstacle to many of the vocational agriculture departments in Iowa. A major company specializing in greenhouse structures lists a basic 22 X 40 foot corrugated vinyl covered

greenhouse as costing \$2826 for materials with an additional \$1257 for heating and cooling systems (60). This totals \$4043 for the materials and basic equipment, but does not cover the labor cost for construction and the plant material itself. These additional costs could run as high as another \$2000 to \$3000, causing many schools to seek alternative methods of meeting the instructional needs of their students.

Behavioral changes of students may be brought about by exposure to material and activities which increase knowledge and stimulate curiosity. In the present day with increasing audio-visual and published materials in the field of agriculture, it seems unwise to prevent students from having adequate use of these learning devices and materials.

In his paper, New Concepts in Education and Learning Theory, Ralph Tyler, as cited by Opacinch et al. (46), lists several conditions for learning. These include:

1. The learner carries on the behavior he is to learn and obtains satisfaction from it.
2. The student must be actively involved.
3. The student needs to have clear models of behavior to guide him.
4. The student must have materials to work on.
5. The student must have time to carry on this behavior, to keep practicing it.
6. There should be an opportunity for a good deal of sequential practice that goes more broadly and deeply with each subsequent practice.
7. It should be possible for the student to set high standards of performance for himself.
8. The learner must have a means of judging his performance to be able to tell how well he is doing.

Munger and Steen (40, p. 15) underscore these concepts put forth by Tyler when they state:

Today the American student must assume more and more individual responsibility for his academic achievement if his later progress is to be enhanced. No longer can the student who has failed to realize his capabilities place the blame entirely upon the teacher. To develop responsibility, the student must be given a chance to assume responsibility.

Applying the ideas and beliefs of educators to the needs of workers in horticultural occupations, alternative solutions are required to provide a total learning experience for students in horticulture programs in Iowa that lack resources which are instrumental in developing needed competencies. It was the purpose of this study to investigate the effectiveness of instructional media in teaching specific competencies selected by the researcher. For this study, the researcher assumed that media replace traditional methods of instruction for a specific unit of instruction dealing with plant material identification rather than being the main medium of communication or experience for an entire horticulture curriculum. Therefore, the instructional media for this experiment was used for a two week period and only with the phase that dealt with plant identification. It was also assumed that student achievement should be the basis for evaluation of the effectiveness of the technique used.

Specifically, the objectives of this study were:

1. To determine the effectiveness of instructional media in teaching the common names of ornamental plants as measured by student achievement.
2. To determine those factors which are related to achievement in horticulture when instructional media are used.

3. To determine the implications for the use of instructional media in horticulture programs.

It was with these objectives in mind that the researcher designed and conducted the experiment involving alternative methods of teaching plant identification. There are no magic formulas for teaching success. Like farming, good teaching requires hard work, but successful agricultural practice today requires considerable application of new techniques, chemicals, and marketing skill. Most teachers apply a comparatively small part of the knowledge available on teaching to the cultivation of students' minds when compared with the modern farmer's application of knowledge in his cultivation of plants and animals.

REVIEW OF LITERATURE

The importance of developing good instructional materials relative to the diversified instruction in vocational agriculture programs has taken on a new dimension with the increased emphasis on individualized instruction and recognition of those who are classified as disadvantaged students. Additional emphasis has been given to integrating instruction in the various disciplines or attempting to make the so-called academics relevant to the aims, goals, and ambitions of students enrolled in vocational areas.

Hannemann (15) attempted to determine the type of instructional media to which teachers of agriculture have access and which they use. His findings indicated the 16 mm motion picture projector to be the predominant item of instructional equipment available to teachers of agriculture. Other items readily accessible included the 2 x 2 inch slide projector and film strip projector with more and more teachers gaining access to 8 mm film loop projectors.

In 1968, Smitley (55) studied the use of visual material in teaching ornamental horticulture. A purpose of his study was to develop a workbook of drawings and descriptions to be used along with a set of color slides. Recommendations arising from this study include: (1) that drawings, descriptions and slides be changed as experience with their use is gained, (2) that more slides showing seasonal changes in the plant should be added, (3) that a set of overhead projector transparencies be made, (4) that the effectiveness of such an approach to individual instruction be compared with other methods, and (5) application of these procedures should be

extended to all areas of horticulture which include identification of plants.

Matteson and Thompson (34) conducted a study in 1967, to determine the need for instructional materials in high school agriculture in Wisconsin. Their findings indicated that approximately 84 percent of the teachers had changed their high school programs within the previous three years thereby greatly increasing the need for additional up-to-date teaching materials. Most of the teachers indicated a great need for additional instructional materials which could be prepared in a materials preparation center and would greatly enhance their teaching programs.

A further review of the literature related to instructional media revealed considerable research work conducted in various subject matter areas and at various grade levels. The majority of these studies dealt with the biological sciences and related fields of study. These studies used different approaches in attempting to determine the most effective method of instruction for selected subject matter areas with various degrees of success. The review of literature involving these studies will be broken down by method of instruction investigated to aid the reader in more clearly evaluating the research previously conducted.

Audio-tutorial Instruction

This approach has the capability of integrating and appropriately sequencing the use of learning media and materials. It can be readily adapted to the great variation in students' backgrounds, aptitudes and interests, while it still places the responsibility for learning on the

student (58). It also has the distinction of being the method of instruction most widely investigated.

Nordland et al. (44) describes audio-tutorial instruction in the following manner:

The audio-tutorial approach utilizes an audiotape to pace students through integrated laboratory, lecture, discussion, and demonstration activities. Behavioral objectives, learning for mastery, self-pacing, multi-media activities, repetition, and reinforcement are incorporated into a carefully designed and sequenced audio-tutorial lesson.

Experience has shown that this system has many practical uses in meeting a variety of educational problems. Classroom applications have included a range of involvement from a single carrel, used for remedial and/or make-up work, to a total, self-pacing audio-tutorial laboratory.

Basically, three problems are faced when a teacher decides to adopt an audio-tutorial program. First, conversion of existing facilities without loss of flexibility; second, selection and cost of equipment or hardware; and third, production of appropriate instructional material or software.

S. N. Postlethwait, a biology professor at Purdue University, has been a pioneer in the use of audio-tutorial instruction. He was concerned because some of the students who had weak backgrounds in botany were unable to keep up with the class. Consequently, he began putting supplementary lectures on audio tapes for use by these students at times convenient for them. In the beginning, photographs and diagrams were made available so that the students could be directed, by the tape, to examine some item being discussed on the tape. As the tapes progressed, the student was directed to open his textbook and follow the explanation offered there in

conjunction with the lecture on tape. As time went on, living plants were added to the packet of materials and finally a lab manual was included wherein students were instructed to do certain experiments in conjunction with each lesson. By the end of the semester a learning kit was prepared weekly, thus the students could actually complete an entire week's assignment without ever having to attend the classroom sessions. Since the students responded so favorably to this idea, 36 students were offered the entire course via tape. Once each week an instructor would meet with this section to discuss the material covered that week and to test the students. These students were required to take the same examinations as students in the conventionally-taught classes. A comparison was made at the end of the semester of the two groups, and the results showed no difference in the achievement. The 36 students who were in the experimental group were interviewed to obtain their opinions as to how a flexible program could be set up that would also provide the quality of instruction necessary to prepare them for advanced studies in science. As a result of these interviews a freshman botany course at Purdue was permanently established utilizing audio-tutorial instruction (49).

Since Postlethwait's original study using audio-tutorial instruction Detroy E. Green, agronomist at Iowa State University, initiated a study in Agronomy 114. The teaching staff for this course went to Purdue University in 1965, and garnered firsthand information from Postlethwait about his experiment. A conventional laboratory was set up for this course in the fall, and then due to dissatisfaction with this method an audio-tutorial station type of instruction was established during the winter

quarter. Green (13) feels that success of this type of instruction depends on:

1. Brief, concise instructions at each station.
2. Good study material at each station.
3. Enough stations so that the students can have ample space for study.
4. Classrooms which can be kept open all day and possibly evenings.
5. Laboratory instructors who are willing to give up the lecture method of presentation and walk several miles during each laboratory period "nipping" at the lazy students, challenging the fast students, and answering questions as needed.

Audio-visual tutorial aids have been used extensively by several departments in the College of Agriculture at the University of Illinois. The Department of Agricultural Engineering uses four single lesson units with audio-visual tutorial aids for teaching surveying skills. The units may be easily used as make-up material for those students who miss the lecture presentation or who require additional study. The units also provide an opportunity for review for those students who need information obtained in a previous course.

Retention increases with involvement, and the tutorial units involve the student. Not only is he involved in operating the unit in the carrel, but if the unit is properly planned, he will be involved in answering questions or solving problems during the course of the presentation.

Audio tape and slide units have the additional advantage of being easily updated. Magnetic audio tapes can easily be erased and recorded again, and new slides can be added with a minimum of trouble.

The use of audio-tutorial units is advantageous to the student as well as the instructor. He is able to assimilate the material at a time of his own choosing and at a rate he prefers. If a portion of the unit is puzzling to him at first, he may repeat that portion until he understands the material. He can stop the presentation at any point to take notes on material that could be presented too quickly in a lecture.

Mitchell et al. (38) reported that the audio-tutorial units used in Agricultural Engineering at the University of Illinois provided an excellent method for learning basic skills and understanding equipment. Mitchell went on to say that audio-tutorial units can be effective teaching aids if properly developed. Used with other teaching methods (lectures, laboratories, demonstrations) they provide a mixture of learning experiences which has great benefit for both the instructor and the student.

Numerous experimental studies have been conducted in which the audio-tutorial method of instruction was compared to traditionally-taught classes and/or other instructional media approaches.

Opacinch et al. (46) designed a multidisciplinary approach for an introductory level biology course. The three different modes of teaching utilized were: (1) audio-tutorial approach, (2) a television presentation aired by the local public broadcasting station, and (3) straight lecture. In order to determine the effects of the three different teaching methods on learning, at the conclusion of the course all students were tested with the same fundamentals of biology instrument they had been given upon entering. A one-way analysis of variance was computed on posttest scores and

the resultant F-value was not significant. There was no significant difference among the three groups of students on their achievement level after completion of instruction. The growth in biological knowledge of individual students enrolled in audio-tutorial, lecture, and television sections was also examined by Opacinch. A one-way analysis of variance was computed on the gain scores for the three groups of students and the resulting F-value from this analysis was also not significant.

An exploratory study of the audio-tutorial (A-T) method of instruction in general biology was made by Himes (18) during the academic year 1970-71 at Bloomsburg State College. Experimental and control groups were established during each semester of the investigation. Only freshman students were involved in the study. Effectiveness of the A-T method was measured using scores on examinations taken by students in the two groups each semester.

The A-T approach showed no evidence of enhanced benefits during the fall semester. The researcher felt this was largely due to inexperience on his part which influenced the outcome during the initial semester of the program. However, the second semester saw the program in a more efficient state of operation and the results were strongly positive to the A-T technique. Significant differences at both the .05 and .01 levels appeared rather consistently. Students in the A-T program had significantly higher scores on the examinations than those students in the control group where the instructional approach was of a more conventional nature.

Himes also found the performance of the male students in the experimental groups was consistently higher as opposed to the male students in the control group indicating a significantly positive value to them of the A-T method of instruction. Differences in achievement between the females of the two groups were less striking, but still indicative of value in the A-T approach of instruction.

Himes also reported that student response to the A-T program was almost universally favorable. Of particular emphasis was the more personal interaction between instructor and student. Students were especially pleased with the opportunity to work on their own at their own pace, yet have immediate reinforcement from the instructor, either personally or via the audio tape. These results led Himes to conclude that instruction in general biology using the audio-tutorial approach has significantly positive value.

In order to determine the effect of a method of instruction on student achievement and student attitude, Rowsey (52) made a comparison between a control group and an experimental group. The control group was composed of 190 students enrolled in Animal Biology 103 at Auburn University during the Winter Quarter of 1973. These students were taught in a conventional lecture-laboratory manner by instructors who had previous experience in teaching the course. The students in the experimental group were those 134 students enrolled in Animal Biology 103 during the same time period, but received their instruction by means of the audio-tutorial program. The course syllabus was identical for both groups. The major findings of this study were:

1. Students taught using audio-tutorial instruction demonstrated significantly greater achievement gain, but did not differ significantly in attitude toward course content.
2. An analysis of the opinion questionnaire revealed a favorable reaction by the experimental group toward the use of the A-T method of instruction.
3. The experimental group spent a significantly greater amount of time in formal study than those students taught by the conventional approach.

Grobe (14) conducted a study employing the Pretest-Posttest Control Group Design to investigate the effectiveness of audio-tutorial instruction in college biology for nonscience majors. The population consisted of students enrolled in Biology 101 at the University of North Dakota during the fall term of the 1969-70 academic year. Thirty-eight students were randomly assigned to an A-T biology course and were designated as the experimental group. Forty-one students were randomly assigned to receive the conventional biology course and were designated as the control group. At the start, students in both groups were given the College Entrance Examination Board Advanced Placement Exam in Biology. Next, students in the experimental and control groups were exposed to identical content areas in biology for the same length of time by either the A-T or conventional methods of instruction. Finally, a posttest was administered to both groups at the conclusion of the study. The posttest was an alternate form of the pretest. Additional data consisting of ACT rank, science background, and size of secondary school were gathered on all students in the study and used to identify subgroups within the population sample.

Posttest data were analyzed by use of analysis of variance and multiple linear regression. The findings indicated that no significant

difference in achievement at the .05 level existed between students who had been taught biology by either the A-T or conventional methods of instruction, and also, that the relationship between a student's aptitude and achievement in biology is not significant at the .05 level under either method. As well, the effects of a student's secondary school size and science background were not significant in promoting achievement by either method of instruction.

In other work dealing with biological science, Elliott (12) designed a study to determine the effectiveness of audio-tutorial minicourses in increasing achievement in the biological sciences at the college freshman level. Data were based on the Otis Self-Administering Test of Mental Ability: Form A, and a general biology pretest and posttest. The findings indicated that audio-tutorial minicourses used as an adjunct to lecture and laboratory techniques did assist students in learning, as indicated by student evaluation. However, the study found no significant differences to exist between the posttest means of the audio-tutorial group and the control group when the data were treated by analysis of covariance.

Marinos and Lucas (33) conducted a study to determine the value of audio-tutorial instruction on retention of information learned during the period in which the subject matter was presented. The experiment involved the division of a plant physiology class into two intellectually equivalent groups, both of which took the same course in terms of information content and basic approach. One group (control) attended two one-hour lectures plus one three-hour laboratory session per week, while members of

the other group (experimental) worked at will through an audio-tutorial version of the course. Both versions of the instructional mode were given by Marinos.

An unannounced retention test of 20 short free response questions was given at four months and again at twelve months after completion of the course. The retention test was administered anonymously, with students being requested only to identify their answers with "Control" or "Audio-tutorial" depending on the method by which they were taught.

Marinos reported no significant difference between achievement of the two groups as measured by their performance in the course. However, the A-T group consistently scored significantly higher at both the four month and twelve month retention intervals as measured by the researcher. These results point out further valuable attributes of using nonconventional methods of instruction coupled with those that have already been discussed.

Another important characteristic of media oriented instruction is its efficiency. It has been reported in several studies that audio-tutorial instruction is as effective or more effective than the traditional approach of education. Barry et al. (1) investigated the possibility of students utilizing time more efficiently with the use of instructional media. In his study, Barry evaluated the effectiveness of a series of slide-audio tape instructional programs for the first semester of a two-semester course in general chemistry. The general format for teaching the course was lecture, discussion, and laboratory, supplemented by out-of-class use of the slide-tape programs. The programs were used in study carrels equipped with a slide projector and a cassette audio tape playback

unit. The audio tape provided instructions for changing slides, for computation pauses, for worksheet exercises, and other relevant activities. A record of the amount of time (in minutes) that each student spent on each program was maintained and this time record constituted the independent variable for purposes of analysis.

Students who elected to use the slide-tape programs were compared with those who did not use them on the basis of laboratory grade, quiz grades, and course final grade. Analysis of covariance was used to compare the achievement scores of users and nonusers of the programs. American College Testing Program (ACT) composite score was included as a covariate to adjust the achievement measures for differences in academic ability between the user and nonuser groups.

In all instances, students who elected to use the slide-tape programs had higher average achievement than those who did not use them, although the magnitude of the difference was not large enough in all instances to be statistically significant.

To determine whether the amount of time devoted to the slide-tape programs by those who used them was related to achievement, the correlation coefficient between each achievement criterion and the amount of time spent on related programs was calculated. Most of the coefficients were positive, but in only one instance was the correlation coefficient large enough to be statistically significant.

From this experience with the slide-audio tape programs, Barry et al. felt they were an effective teaching tool. On the average, students who used the materials attained a significantly higher level of achievement

than those who elected not to use them (1, p. 538). On the other hand, there seems to be little or no relationship between achievement and the amount of time users spend on the programs. This latter finding is consistent with a number of related studies which have found college scholarship to be essentially uncorrelated with hours of study. It appears that more important than time alone (beyond a reasonable minimum), are variables such as motivation to achieve and study methods. In Barry's evaluation, sufficient motivation to use materials seemed to be a critical variable.

Stuck (58) also investigated the efficiency of the audio-tutorial method of instruction with highly positive results. Stuck attempted to determine if there was a significant difference in learning under audio-tutorial methods and traditional lecture methods of instruction in school law. The experiment was designed in such a way that 219 students in Education 426 at Iowa State University were randomly divided into experimental and control groups. The control group was subjected to the lecture method of instruction for a unit on school law, and the experimental group was taught the same unit concepts audio-tutorially using specially prepared simulated materials. All of the students were pre- and posttested to measure growth over time and were given a retention test two weeks after the posttest.

The only significant F-value emerging from the study, that was pertinent to this investigation, was in the two methods of instruction. The results indicated that the audio-tutorial method of instruction was significantly better than the lecture method. The other factors and their

interactions did not significantly affect the ability of the students to learn in this experiment.

Actual time was recorded by each student as to the amount of time he spent on the unit during the experiment. The group utilizing the lecture method spent 38.44 percent more time on the unit, yet the audio-tutorial group achieved significantly higher scores on the posttest administered by the researcher (58, p. 78).

The results reported by Stuck give support to the ideology that in many cases audio-tutorial instruction can be a more effective and a more efficient means of teaching than the traditional or conventional method.

The use of audio-tutorial instruction in other areas of education was reported by Johnston (23) when he designed a study to determine if audio-tutorial materials could be developed for instruction of junior high mathematics students and to compare the effectiveness of audio-tutorial instruction versus a traditional method of instruction.

The sample studied consisted of 139 students (71 in the audio-tutorial sections, 68 in the traditional sections) enrolled in seventh grade mathematics in the Boone Junior High School, Boone, Iowa, during the first semester of the 1968-69 school year. The traditional group was taught by the lecture method of instruction, and the experimental group was taught by the audio-tutorial technique using specially adapted materials and procedures. All the students were pre- and posttested to measure growth over time.

The statistical procedure used by Johnston was multifactor analysis of covariance, which allowed a study of the performance of the six groups

of students which were unequal, by equating statistically the dependent variable of preachievement test, intelligence tests, and grade-point average. The main effects of the experiment consisted of group, sex of students, and teachers.

The results of this study indicated that all of the computed F-values were nonsignificant at either the .01 or .05 level of significance. Therefore, the hypothesis that there would be no significant difference in the postcourse mathematics achievement of the audio-tutorial and traditionally-taught students could not be rejected.

However, the students in the experimental group, although not performing significantly better than the traditional group, expressed a preference for the audio-tutorial method of instruction. In a survey conducted by Johnston, 75 percent of the experimental group indicated they wanted to continue this method of instruction.

The field of agriculture has been instrumental in introducing the use of audio-tutorial instruction into the classroom in a variety of subject matter areas. In 1966, shortly after the conception of audio-tutorial programs, Lee (30) initiated a study at Iowa State University to compare the effectiveness of audio-tutorial type instruction versus a traditional laboratory method of instruction in Agronomy 114A. The sample consisted of 519 students (148 in the A-T group, 371 in the traditional method group) enrolled in Agronomy 114A during the academic year 1966-67.

Lee (30) reported there was a significant difference in the variance of means on test scores, with the audio-tutorial method proving superior to the traditional method of instruction. The analysis of variance

findings based on laboratory final exam (adjusted for pretest) showed no significant difference based on method of instruction. However, on the weekly laboratory quizzes (adjusted) there was a highly significant difference at the .01 level based on method and also on the quarter in which instruction was received, with the audio-tutorial section performance being the best.

Based on the overall laboratory grade (adjusted for pretest) there was again a highly significant difference at the .01 level for the method and also the quarter of instruction. The results of these differences, based on quarter, indicated spring quarter students outperformed the previous quarters. Consequently, the audio-tutorial method of instruction proved to be superior to the traditional method of laboratory instruction in Agronomy 114A.

Lee's findings also revealed there was a difference in the time that each group spent during the experiment conducting laboratory exercises. The group utilizing the audio-tutorial method of instruction spent an average of 15.97 hours per student while the average of the traditional method group was 16.94 hours per student, which amounted to 6.07 percent less time required by the audio-tutorial group to complete the laboratory instruction.

An added benefit of the audio-tutorial instruction was found when it was determined that fewer students dropped or failed to complete the course in the audio-tutorial sections. Overall, the audio-tutorial method experienced a 3.94 percent drop rate compared to a 6.31 percent for the traditional method.

Using a course in principles and procedures of small power equipment, Petersen (47) studied the effect of audio-tutorial instruction versus the traditional approach. There were 28 juniors and seniors enrolled at Iowa State University during the spring quarter of 1970 that participated in the study. Petersen identified 23 variables in an attempt to select factors which increase the effectiveness of the audio-tutorial method of instruction.

Stepwise regression analysis was employed to identify which variables affected the treatment technique to the greatest extent by measuring the amount of variability which could be accounted for by the treatment of each variable. Analysis of covariance was used to test the hypothesis that there was no significant difference in student achievement in the classroom attributable to the use of audio-tutorial sequence-programmed lessons. Petersen (47) rejected this hypothesis as he found a significant difference between the control and treatment group in favor of the treatment group. It was in his opinion that the audio-tutorial technique could: (1) be effectively used for individualized instruction, (2) increase student motivation, and (3) reduce the time required to teach students (47, p. 74).

Oen and Sweany (45) conducted a study in horticulture to compare the effectiveness of individualized and lecture-discussion methods with a noninstructional (control) method in developing turfgrass competencies in 11th and 12th grade students. In this experiment, teachers from 29 Michigan schools were randomly placed in three groups and attended workshops where they were provided with manuals, accompanying slides, audio-

visual and curriculum materials, and an explanation of the study procedures. Five antecedent variable pretests were administered to the 632 students, and at the conclusion of the project, a battery of seven posttests was completed by the students.

Results reported by Oen and Sweany revealed that the mean posttest scores were higher for students taught by the two instructional methods than the control group, and the mean posttest scores of students receiving individualized instruction were significantly higher than those receiving the lecture-discussion method after removing the variance attributed to each of the antecedent variables. However, when the posttest scores were analyzed as a composite package, there were no significant differences between the two instructional methods. Thus, in this study Oen and Sweany (45) were able to achieve comparable performance between a lecture oriented method of instruction and individualized instruction by the use of specially developed media on turfgrass competencies.

In a project designed to experimentally evaluate various instructional methods in vocational agriculture, McVey (36) reported that the audio-tutorial technique was an effective media in assisting teachers of high school vocational agriculture. In this study, McVey prepared four audio-tutorial programs for instruction in animal health, commercial fertilizers, small gas engines, and farm credit. Twelve vocational agriculture departments in Iowa were randomly selected to participate in the study, with six randomly assigned to the experimental group and six to the control group.

As reported by McVey, statistical analyses used to reveal differences between the audio-tutorial and the control schools in magnitude of change

in knowledge from the pretest to the posttest yielded nonsignificant values for each of the four class levels and three of the four subject matter areas. The lone exception occurred when the audio-tutorial technique was more effective in teaching farm credit than was the traditional method used by the control schools.

Instruction Utilizing Color Slides and Filmstrips

In 1953, Solstad (57) attempted to experimentally evaluate the effectiveness of slides and filmstrips in teaching selected vocational agriculture units. He reported there were no significant differences in the performance of his experimental and control groups. As Solstad pointed out, while the value of slides and filmstrips may vary according to studies implemented, there remains qualities that cannot be measured by means of an objective test.

Solstad stated the reasons for using slides and filmstrips are basically threefold: (1) holding attention, (2) clarification, and (3) emphasis. Other ways in which this media can be used include (57, p. 65):

1. To teach facts.
2. To teach manipulative skills.
3. To show processes.
4. To teach concepts.
5. To develop attitudes and interests.
6. To provide entertainment.

A study was conducted by Kochevar (29) to determine the effectiveness of filmstrips in teaching educable mentally handicapped students. Criterion instruments used were a first aid subject matter test, and a practical

first aid psychomotor knowledge and skills test. The experiment was carried out at six Denver, Colorado, junior high schools involving 218 students.

Based on the findings of the study, Kochevar concluded that teaching educable mentally handicapped students with the aid of a filmstrip results in significant learning. Using a filmstrip to introduce a unit, together with repeating the filmstrip immediately, were the best methods of utilizing a filmstrip when attempting to teach educable mentally handicapped students.

Carey (8) investigated the effectiveness of colored slides and script for teaching protection from fallout in rural areas to high school agriculture classes. These teaching materials were developed in recognition of the lack of experience and lack of background among most teachers who would be expected to use the materials. Also, a verbal presentation was prepared to be used in lieu of visual materials and in addition to visual materials with different groups. Findings indicated that greater learning had taken place when the colored slides accompanied the verbal presentation.

Other uses for color slide media have been found over the years, enabling teachers to add a new dimension to their teaching. Hughson (20) reported using slides to illustrate the operation of electronic equipment to freshman nursing students. Color slides made it easy to color code the various connecting leads in electronic circuits.

The slides were used with live narration to permit questions. This allowed Hughson with one assistant to keep a section of 20 students moving

steadily through an experiment. This procedure increased the time efficiency for both instructor and student.

Instruction Involving Films and Video Tape

A more recent innovation in the use of instructional media involves the utilization of video tape equipment and specially produced single-concept films. Motion pictures as a teaching aid have been available for classroom use for the last 40 to 45 years.

In 1950, Vander Meer (61) designed a study to determine whether and to what extent instructional films can carry the entire teaching burden in a course involving the teaching of a body of factual information. Three comparable groups of ninth-grade high school students were taught a four-unit course in general science over a period of a full semester. One group was taught by being shown a series of 44 films alone. The second group was taught by being shown these films and by studying, before and after each film, specially prepared short study guides. The third group was taught by teachers using a standard textbook, and conventional classroom teaching techniques other than film.

The students were given objective-type tests immediately at the end of each unit, and a retention test covering all four units three months after completion of the course. They were also tested before and after the experiment with a standardized test of general science knowledge.

Analysis of the data reported by Vander Meer revealed that differences between the three groups were small and generally not significant. The Films Only group in six out of 48 comparisons earned slightly lower mean scores than either of the other two groups in immediate recall tests,

while both film groups performed slightly better than the Conventional method group on delayed recall tests (61, p. 2-3).

The overall results of this study suggest that a body of factual information, such as high school general science, may be taught by films alone, almost as effectively as by a teacher using conventional classroom methods; and by films introduced and supplemented by brief study guides perhaps a little more effectively than by conventional nonfilm teaching methods.

However, it should be borne in mind that the measure of effectiveness adopted in this study has been solely the learning of factual information. We as educators believe that teachers provide greater motivation, interest, and inspiration, as well as aid in the development of critical thinking ability through classroom discussion.

Less evidence in support of film media was reported by Klit (27) when he conducted a study to evaluate the effectiveness of single-concept films as an instructional technique in vocational agriculture. The subject matter areas included animal health, commercial fertilizers, small gasoline engines, and farm credit. The study involved six schools randomly assigned to the single-concept film treatment group and six schools randomly assigned to the control group. Twenty-one single-concept films were produced which were used in teaching the specific units in the treatment schools. The control schools taught the same units without the aid of the films.

When the data were analyzed from the two-factor experiment comparing the magnitude of change in knowledge from the pretest to the posttest

scores for the four subject matter units taught, it was found that the magnitude of change was not significantly different in the commercial fertilizer, small gasoline engines, and farm credit units. This did not hold true for the animal health unit. Here the magnitude of change was found to be significant with the control schools having a greater increase in scores from pre- to posttest than did the treatment schools.

Klit reported that when single-classification analysis of variance was computed on the posttest scores of the treatment and control schools, the computed F-value approached significance in favor of the control schools in all subject matter units (27, p. 84).

In contrast to previous findings, this study concluded that vocational agriculture students seemed to achieve no differently when taught with single-concept films as when taught similar subject matter in a traditional manner.

A more recent development in the way of instructional media to appear on the educational scene has been the use of video tapes. In 1969, Pothoven (50) initiated research to evaluate the effectiveness of video tape in presenting a portion of the subject matter to students enrolled in a metals course at the university level. Demonstrations related to the classroom work were taped to evaluate their effectiveness as an instructional tool when compared to the traditional lecture method.

The experimental group received five video-taped units of instruction about metals and metal working, varying in length from 25 to 35 minutes. The control group covered the same instructional units using the traditional lecture method.

Comparisons were made on the performance of the two groups in the classroom over written work, and in the laboratory over job skills. A nonsignificant F-value was calculated when pretest-posttest differences were compared for the treatment and control groups. This indicated that video tape did not significantly increase initial learning when compared to the traditional approach. However, the treatment group pretest-posttest difference was 12.83 compared to 12.06 for the control group. This would tend to indicate that video tape as a supplement in the lecture did appear to increase slightly, initial learning of the student (50, p. 58).

Pothoven further reported that when scores on laboratory exercises were compared for the treatment and control groups, an F-value was revealed to be significant at the .01 level. The control group averaged 314.58 for the four metal laboratory skills compared to 328.00 for the treatment group. This indicated video tape can be used as a supplement in the lecture to improve students' ability to perform laboratory skills.

Similar results on the use of video tape as an instructional mode were reported by Hanson (16) when he conducted a study that involved the comparison of video tape instruction to the traditional method of teaching units on animal health, commercial fertilizers, small gas engines, and farm credit. Twelve schools were randomly selected from the Iowa vocational agriculture departments with six schools assigned to each the treatment and control groups.

Hanson prepared four video-taped segments for each of the four subject matter areas covering specific objectives to be taught on the days the topics were to be shown.

At the end of the experiment, the students were administered a posttest identical to the pretest. Both the posttest score and gain between pre- and posttest were used as dependent variables to evaluate achievement. The analysis of the posttest scores identified significant differences in favor of the control group at the .05 level of probability in the small gasoline engines unit. Differences between the two groups' posttest scores for the other subject matter units were not significant.

When gain scores were used as the dependent variable, significant differences were again found between the groups for the animal health and small gasoline engines units in favor of the control group at the .05 and .01 level respectively.

Even though the study did not show differences in favor of the video tape group, there may be advantages for using this media other than its effect on student achievement. Hanson (16, p. 78) lists the advantages of increased interest and motivation of students, savings of preparation time of teachers, and savings in travel time to obtain certain class experiences as being justification for the adoption and use of media.

Audio Instruction

Slides emphasizing visual elements can be enriched by using crisp, concise, audio-taped commentaries to focus attention on essential points in each illustration. The cassette audio tape offers several advantages which are ease of handling by the student, ease of production on the part of the teacher, relatively low cost, ease of storage, and an unlimited storage life.

Brandt, Ansell, and Cryer (6) developed a type of self-instruction program for a first-year physics laboratory at Chelsea College in London, England. The instructional material included programmed scripts, textbooks, films, and audio cassette tapes. In their course of study, the main instruction was given by tape. This required the student to concentrate and does not allow him to scan the material rapidly, as it often occurs with written directions.

Brandt et al. reported that the tapes have proved particularly helpful in discussing diagrams and graphs. The success seems to be in that the student was using his ears as well as his eyes. Tapes also had the advantage of making it particularly easy to integrate other learning resources such as instruction sheets, textbooks, study guides, and films (6, p. 25).

The subject of educational evaluation has received considerable attention, and undoubtedly it will continue to receive the same or even greater interest in the future. Evaluation of the educational process is, however, difficult due to the fact that it does not lend itself adequately to objective or quantitative assessment.

Phillips (48) attempted to determine the effectiveness of three methods of presentation on student achievement. The three methods under consideration by Phillips were: (1) taped lecture method, (2) taped lecture with visual aids, and (3) handout method. In this study, it was felt that adequate control was exercised over extraneous variables in order to objectively assess the effectiveness of the teaching methods.

The analysis of variance was used with a two factor, crossed, fixed model. The intent being to determine whether or not significant differences existed between the three methods of presenting material.

Based on this analysis, Phillips reported that the taped lecture with visual aids was the most efficient method of presenting subject matter. The recommendation of using the taped lecture with visual aids would permit the student to involve both the perception of sound and sight. Also, during the presentation, he would be encouraged to maintain the rate at which the material is being presented. However, using the handout only method, the student would depend entirely on his proficiency in reading and would receive no outside influence to maintain a desirable rate of coverage of the material. The lecture alone method would force the student to receive the material only through his auditory receptors, which tends to limit his intake of the desired material.

Education must be more than presenting material. It must stimulate student motivation into directions which will provide positive guidance for future endeavors. As Alfred North Whitehead stated, "Education is the acquisition of the art of the utilization of knowledge." It is an activity which is essentially alive and inspiring, not simply a transfer of information. The only real value of knowledge is when the student can use it in a meaningful way.

In other studies using audio tapes, Menne and Hannum (37) substituted taped lectures on an individual basis for the whole classroom situation, and compared that technique with the traditional lecture using an introductory psychology course at Iowa State University. The experimental

subjects agreed: (1) not to attend the live lectures, (2) not to allow control subjects to listen to tapes, and (3) not to copy the tapes issued to them. Each experimental subject was left free to proceed at his own pace, however, he was required to take the three exams given over the course material. All exams were of the objective, multiple-choice type.

Menne and Hannum reported that the results of this study confirmed previous findings that taped lectures can be as effective as the traditional lecture presentation in supplying information. Given a recorder and a set of tapes, students can and will learn as much about the course material as would students who attended regular classroom lectures (37, p. 46).

Field Trips

An instructional method that does not involve media, but yet is different than the conventional approach to teaching, is the field trip. This technique is popular with vocational agriculture instructors and has its primary use in the vocational area.

In 1970, McCaslin (35) conducted an experiment to determine the effectiveness of field trips on student achievement in the areas of animal health, commercial fertilizers, small gasoline engines, and farm credit. Six schools were randomly assigned to the treatment (field trip) group and six schools were randomly assigned to the control group. All twelve schools that participated in the experiment were provided with the same reference material and varied their instruction only in the use of field trips by the six treatment schools. A total of four field trips

were planned for each of the units of instruction. They consisted of planned visits to points outside of the classroom or shop that could be completed in a regular class period. These field trips were to farms and agricultural businesses in the community.

Analyses for the experiment using pre- and posttest scores were conducted for the animal health, commercial fertilizers, small gasoline engines, and farm credit units. McCaslin reported that no significant differences were observed between the combined mean pre- and posttest scores of the field trip and control schools for the four subject matter areas. Also, when the magnitude of change from the mean pre- to posttest scores in field trip and control schools for each of the subject matter areas were analyzed, no significant differences were found. It was concluded from these results that field trips did not enhance student achievement beyond that level reached by nonfield trip schools (35, p. 92).

Brady (5) designed a study to test the effectiveness of field trips as compared to the use of media in teaching selected environmental concepts. Two dependent variables, student achievement and student attitude, were analyzed. These two dependent variables were analyzed using pretest scores, I.Q., grade-point average, and science background as covariates. The population studied consisted of 104 sophomore biology students who were randomly assigned to a treatment group (field trip) or a control group (nonfield trip).

In the analysis of data gathered, both field trips and the use of media resulted in highly significant differences between pretest and posttest achievement scores. However, Brady reported that a comparison of

field trips to media failed to find a significant difference between the two methods based on posttest scores.

Further analysis revealed a significant difference between pretest and posttest measures of students' attitudes towards environmental problems for both experimental and control groups. As indicated by Brady, these attitudinal changes were small, but nevertheless, in the direction desired. When the two methods were compared, field trip versus nonfield trip, on attitudinal change, no significant difference was found in favor of either method. The failure to find evidence to support either method might be interpreted to mean that either or both methods might be utilized in developing proper attitudes towards environmental problems (5, p. 82).

Multimedia Instruction

Many educators today are proponents of the theory that a steady diet of one type of instructional media will not enhance student achievement beyond the traditional method which is also singular in its approach. Thus, they suggest this is the reason why few researchers report positive results in favor of media when investigations are conducted to determine their effectiveness.

To combat this problem, Volker (63) designed an experiment in such a way that 12 sections of students taking high school biology at Ames High School, Ames, Iowa, during the 1969 school year were divided into an experimental and control group of six sections each. The experimental group received instruction through audio-tutorial laboratories, programmed instruction, audio tapes, 35 mm slides, 16 mm films, and single-concept film

loops. They also employed small group discussion techniques and peer teaching as methods of study. The control sections were taught by a teacher who primarily used the lecture-demonstration method, and little media was used with the conventional method. A pretest, three achievement tests, and a posttest were administered to both groups to measure growth.

As Volker pointed out, the purpose of the study was to compare a multimedia system for teaching high school biology with a traditional, nonmedia approach. The major conclusion reached by this study was that a multimedia system for teaching high school biology can be superior to a traditional method in causing gains in achievement, and in attitudes toward expectation and method (63, p. 79). The latter characteristics of students were assessed through attitude measures and personality scales.

In 1970, Kahler (26) reviewed the components of a major study investigating seven instructional techniques researched in vocational agriculture departments throughout Iowa. These contemporary approaches included: audio-tutorial, single-concept films, video tape, prepared lesson plans, field trips, demonstrations, and transparencies. In his report, Kahler observed that all techniques and resources tested were effective in increasing the students' knowledge of the subject matter. However, none of these techniques were found to be significantly more effective than the traditional method of instruction. It was felt by the research staff conducting this study, that an integrated approach utilizing combined instructional media would prove more successful in motivating students and developing continued interest in subject matter, whereas the novelty of a singular technique would wear off sooner (26, p. 31).

It was further recommended by the project staff that vocational agriculture instructors should make every effort to inaugurate the use of these techniques into their instructional programs. This should be done, however, after the teachers have had an opportunity to carefully study each technique and become fully aware of its potential use and limitations.

Somewhat conflicting results were reported by Holliday (19) as to the effectiveness of a multimedia approach. Holliday hypothesized that more learning can occur if a combination of visual and auditory presentation of materials is used. For his study, Holliday developed three hypothetical concepts in biology and a retention test for each. The experiment consisted of 350 tenth grade biology students randomly assigned to nine subgroups. These subgroups were identifiable by the unique combination of programmed text format and group-paced delivery techniques utilized for each in the learning and subsequent testing sessions.

Holliday reported that an analysis of covariance treatment of the data indicated there was no advantage either in presenting the verbal information using a combination of audio and printed media simultaneously, nor in using the same media in the learning and testing sessions.

Size of Instructional Group

Concern has been expressed by some educators as to the effect instructional group size has upon the use of media and student achievement. It is generally felt that certain media functions with a higher degree of effectiveness when appropriate group sizes are used.

Tindall (59) conducted a study to determine the relationship between class size, subject matter area, and student achievement using each of the following teaching media: audio-tutorial, demonstrations, field trips, prepared lesson plans, single-concept films, transparencies, and video tape. The subject matter areas utilized in the study were: animal health, commercial fertilizers, small gasoline engines, and farm credit.

The size of class that a teacher worked with when using the techniques tested in this experiment did have an effect on student achievement. Tindall reported that the smaller the size of class, the higher the level of student achievement tended to be, regardless of the technique being tested. This held true in general for all subject matter areas involved in the study.

Also emerging as a variable related to student achievement was that of total department enrollment in vocational agriculture. Students whose instructors had departments with large total enrollment, achieved higher in those treatments (audio-tutorial, single-concept film, and prepared lesson plans) where the teacher could rely on the technique being tested to free time for other activities within the department (26, p. 33).

Another study that compared group size and its effect upon student achievement was designed by Hug (21) in which comparisons were made between specific instructional practices. Achievement of students participating in independent study, small group discussion, and large group presentation was compared to the achievement of students assigned to a "control" group.

On the cognitive measure, the study indicated that students were able to meet instructional objectives equally well through independent study, small-group discussion, or large-group presentations, providing the instructional packages are pretested and rewritten for comparable populations. Thus, in Hug's analysis of group size, it appears there was little or no effect on achievement regarding number of students in a class within reasonable limits.

The only substantial effective difference Hug found in the study was in favor of independent study as the students in this group indicated a better attitude toward this mode of instruction than the "control" group. The other experimental groups did not display a significantly different attitude toward their method of instruction when compared to the "control" group (21, p. 247).

Attitudes of the Learner

In previous research studies, several researchers, Brady (5), Hug (21), Johnston (23), Petersen (47), Rowsey (52), and Volker (63), have reported that the use of instructional media or a specific teaching technique has influenced student attitudes in favor of the technique or subject matter involved. Eigen states the following about assessing student attitudes (11, p. 282):

Evaluating student attitudes is a difficult process at best, and unless one is very careful, he runs the risk of examining a method and/or a set of materials, deciding what he thinks the attitudes of students would be, and reading these attitudes into the reactions of students. Specific student reactions in the form of quotations often appear, but these quotations are usually "selected" to support the argument of the person doing the selecting.

To support this statement, Eigen conducted a study involving 72 male students enrolled at the Collegiate School, New York City, in grades nine, ten, and eleven. The students were divided into two treatment groups and were administered two types of programmed instruction on modern mathematics. On the day following completion of the program each subject took an achievement test to measure what he had learned and responded to an attitude scale. The attitude scale presented statements, both positive and negative, concerning programmed instruction. Subjects were instructed to state whether they strongly agreed, agreed, were uncertain, disagreed, or strongly disagreed with each statement.

Of the 16 statements rated by the students, one of the most notable significant differences occurred between the high and low performance subjects, as the high performance students tended to agree more strongly that programmed instruction was the "best method of learning" for good students because they were not held back by the class. Most of the remaining 15 statements did not reach a significance level.

In summation, Eigen makes two clarifying points (11, p. 283). First, it is difficult, if not impossible, to conceive of a typical reaction to "controversial" statements about programmed instruction after a student's first exposure. Attitudes are vastly different from student to student, and it is in Eigen's opinion that students' attitudes toward programmed instruction in general are little different from their attitudes towards other types of instructional media.

Second, the student's total attitude towards the method of learning seems to have no relationship to what he has learned by that method.

When Neidt and Sjogren (42) investigated changes in student attitudes during a course of instruction in relation to instructional media, they found a considerable amount of research evidence had been accumulated, indicating that when newer media such as programmed instruction or educational television are introduced into a learning situation, students are likely to reflect changes in attitude as well as changes in effort. Educators have been concerned about this phenomenon since the Hawthorne experiments initiated in 1924. However, these findings are in disagreement with results reported by Eigen (11), therefore pointing out the difficulty of conclusively assessing student attitudes about their learning.

To substantiate their theory, Neidt and Sjogren (42) measured the attitudes of students enrolled in college courses taught by one of four methods of instruction; programmed instruction, television, small group, and large group instruction. Scales measuring attitude toward a course were administered five times at equally spaced intervals during the period in which the course was taught. Scales were scored 4, 3, 2, 1, and 0 for strongly favorable through unfavorable responses.

There was a consistent decline in the mean scale scores from the first to the fifth administration of the instrument. The mean scores also differed significantly among the methods of instruction on each of the five administrations. The means of the methods were consistently ranked as follows: programmed instruction > television instruction > small group instruction > large group instruction. This points out that students were more in favor of programmed instruction than they were with large group

lecture. The results of this study indicate that attitudes toward a course were related to the method of instruction used (42, p. 276).

The results also clearly demonstrate that a decline in attitudes toward a course can be expected over the time span of the course when only one method of instruction is used. Variation of instructional method during the course, however, may serve to modify this attitude change curve. In fact, Neidt and Meredith (43) demonstrated that a change to programmed instruction from a lecture method during a course resulted in a significant increase in favorability of attitudes toward the course.

The literature thus far has revealed studies that have investigated the use of instructional media in various areas of education with relatively high success, as students performed as good or better when using media, in almost all of the studies made. However, of the research conducted in vocational agriculture utilizing instructional media, none have dealt specifically with ornamental horticulture or the use of plant material as a teaching tool. For reasons previously stated, a study evaluating the effectiveness of instructional media in teaching plant identification is felt to have beneficial results for those who are responsible for providing instruction in ornamental horticulture.

METHOD OF PROCEDURE

The main purpose of this study was to determine the effectiveness of selected techniques in teaching ornamental plant identification as compared to the conventional method of teaching this subject, which utilizes student exposure to actual plant specimens. These techniques consisted of audio-tutorial instruction, filmstrip and script, and lecture-discussion (control). In addition, the effects of certain home, student, teacher, and school characteristics on student achievement were also considered in the analyses of the data.

The objectives undertaken in this study were:

1. To determine the effectiveness of instructional media in teaching the common names of ornamental plants as measured by student achievement.
2. To determine those factors which are related to achievement in horticulture when instructional media are used.
3. To determine the implications for the use of instructional media in horticulture programs.

Selection of the Sample

All vocational agriculture departments that filed a curriculum report with the Iowa Department of Public Instruction indicating they planned to offer ornamental horticulture during the 1975-76 school year were identified. Criteria were established to determine those schools which could be used in the study. The criteria were: (1) a minimum of nine weeks of instruction in horticulture must be offered as part of the curriculum, (2) in this nine weeks of instruction, a unit on ornamental plant identification must be taught, (3) the teacher must have had at least one year

of teaching experience, (4) at least 10 and no more than 25 students were enrolled in each class, and (5) the dates in which the specified unit was taught must be congruent with other schools in the sample.

Information regarding criteria were obtained by questionnaire during the summer of 1975. From the list of 42 schools identified by the Iowa Department of Public Instruction, only 11 met the criteria established by the researcher. Of these 11, eight were selected by the researcher to participate in the study. The audio-tutorial instruction, filmstrip, and control treatments were randomly assigned to six of the schools in the sample, while the remaining two schools self-selected themselves into the greenhouse treatment group by virtue of having existing facilities and plant material. Presented in Table 1 are the names of the eight schools that comprised the audio-tutorial, filmstrip and script, greenhouse, and control groups. The names of instructors and respective enrollments of classes are also given. The geographic locations of the selected schools are shown in Figure 1.

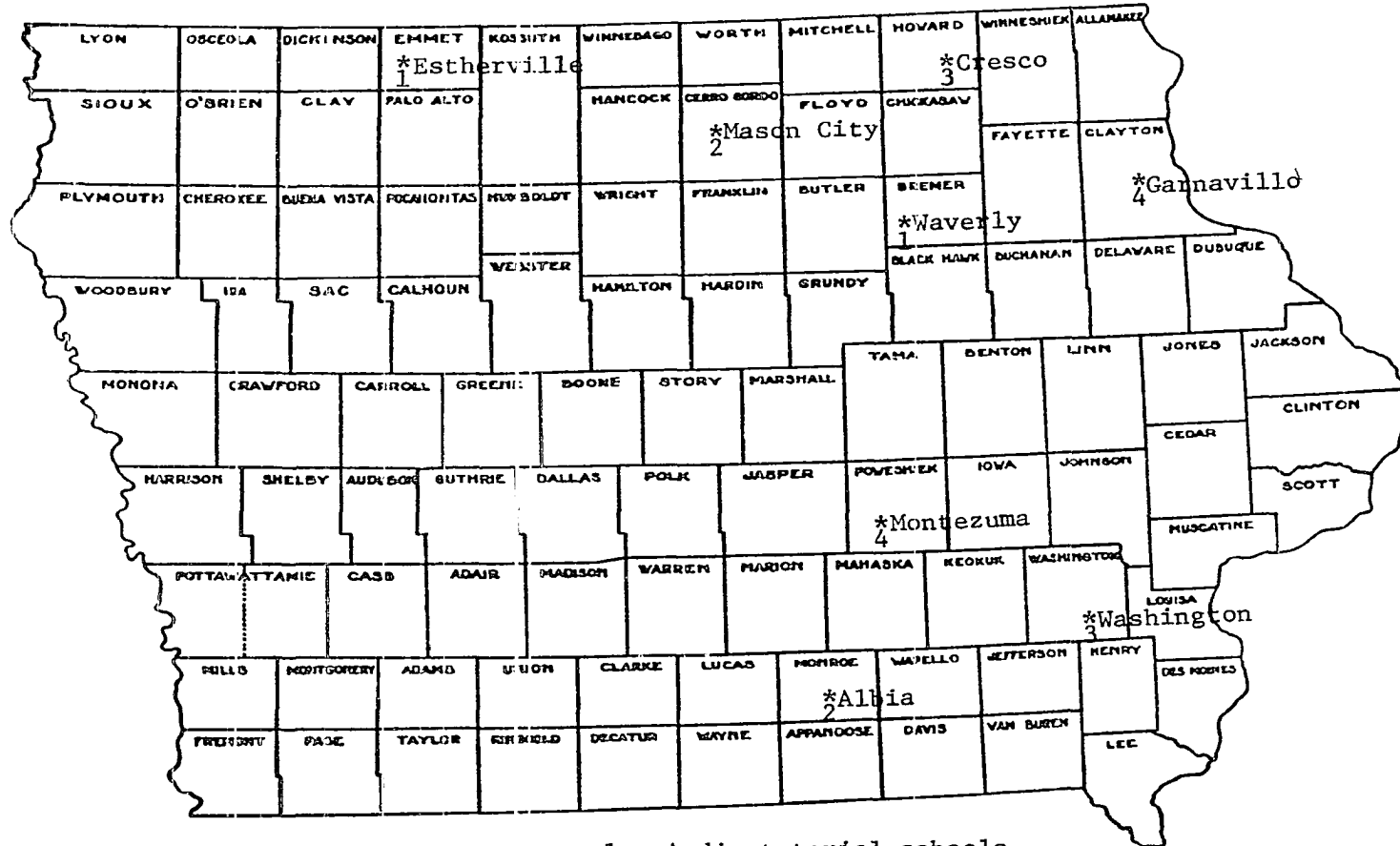
Development of Materials

Most vocational agriculture instructors have access to cassette tape players, 35 mm slide projectors, and filmstrip projectors within their school system. This fact was considered as the selection of media was investigated. The investigator tried during the preparation of the materials used in this experiment to stay within the potential media production capabilities of most teachers of agriculture. For this reason, no commercially prepared material was used in the programming of the treatments studied.

Table 1. Number, sex and grade level of students by technique, school and instructor

Technique	School	Instructor	Grade level ^a				Sex		Total
			1	2	3	4	Male	Female	
Audio-tutorial	Estherville	Dennis Epley	0	0	15	8	5	18	23
	Waverly	David Williams	0	9	1	0	8	2	10
Total			0	9	16	8	13	20	33
Filmstrip	Albia	Lee Daub	0	10	2	3	4	11	15
	Mason City	Kenneth Shadle	0	7	0	4	6	5	11
Total			0	17	2	7	10	16	26
Greenhouse facility	Cresco	Glen Dillon	0	0	12	4	8	8	16
	Washington	Doug Hofbauer	0	2	7	8	6	11	17
Total			0	2	19	12	14	19	33
Control	Garnavillo	John Snopko	0	11	4	6	9	12	21
	Montezuma	Ronald Sheetz	0	0	7	5	8	4	12
Total			0	11	11	11	17	16	33
Grand total			0	39	48	38	54	71	125

^aGrade level 1 = freshman; grade level 2 = sophomore; grade level 3 = junior; grade level 4 = senior.



- 1 = Audio-tutorial schools
- 2 = Filmstrip schools
- 3 = Greenhouse facility schools
- 4 = Control schools

Figure 1. Geographical location of participating schools

A list of 50 common ornamental houseplants was developed by the researcher with assistance from members of the horticulture staff at Iowa State University. A major priority of this list was the plant material had to be available year-round, thus, the majority of these plants were foliage specimens along with some popular cut flowers grown locally. Each student participating in the study received a copy of this list (Appendix A) which contained the common and scientific name of each plant in alphabetical order.

The audio-tutorial instruction program consisted of one hundred ten 35 mm slides, a 60 minute audio cassette tape, 50 plant mounts and a self-instruction study guide. The study guide (Appendix B) listed the specific student objectives to be achieved during the instructional period, self-help test questions, and directions for the use of the program.

Plant mounts were made of the 50 plants serving as the instructional core for this study. Dried plant specimens were placed on 8 1/2 x 11 inch white poster board backing and covered with seal lamin. The common name of each plant was attached to the plant mount.

A majority of the slides were photographed from live situations, with some being reproduced from existing slides or from plant publications. A total of 220 slides were used for the two schools receiving the audio-tutorial treatment.

A script for the audio tape recordings was prepared in outline form and recorded by the author. The outline was practiced several times and then recorded. Duplicates were made using the original recording to reproduce a total of four tapes. An audible pulse was recorded on the tapes

to be used in manually advancing the slides. This method was suggested by personnel at the Instructional Resource Center at Iowa State University as being as effective as the silent synchronizing pulse, as well as having less mechanical difficulty.

An attempt was made to keep the audio discussion accompanying each slide to 15 to 20 seconds with a five second pause between slides to allow students to stop the machine if that option was taken or required. This procedure was also suggested by media personnel at Iowa State University. The audio length per slide was varied depending upon the description required per plant.

The filmstrip treatment was produced from identical slides used in the audio-tutorial segment. A script accompanying the filmstrip was written in a format similar to the audio tape. Two filmstrips and five accompanying scripts were supplied to each of the two schools in this treatment.

Treatment Description

All instructors who participated in the experiment were briefed about their role in the study to acquaint them with the experiment. The instructional period upon which the study was made ran for two weeks. During this time, the instructors assumed responsibility for the administration of the various treatments.

Audio-tutorial

The instructors selected to use the audio-tutorial technique were provided the instructional materials to use. They were instructed in the use of the materials and the audio-tutorial equipment. It was explained to them the necessity of not using other media techniques in their horticultural classes during the treatment period. The instructors were asked to present the program to the entire class on the designated beginning day of the experiment. Study stations were to be provided in the vocational agriculture department, school media center, or other areas for use by individual or small groups of students. Students could review the program as many times as they desired or time permitted.

Filmstrip and script

Instructors using filmstrips and accompanying scripts were asked to present the filmstrip and script to the entire class on the initial day of the treatment. After the initial presentation, the students could use the filmstrips and scripts individually or in small groups in areas provided by the instructor.

Greenhouse and plant material

The treatment schools using live plant material as an instructional mode were verified they had a specimen of each plant on the investigator's list (Appendix A) for research purposes. The instructors were asked to introduce new plants daily during the two week instructional period until all 50 plants had been covered. They were also requested to provide an

area in their greenhouse to display plants with which students could have free access to study plants during available time.

Control

Instructors in control treatment schools were asked to use the lecture-discussion method to verbally describe the ornamental plants on the research list. As in the other treatments, these instructors were asked not to use other forms of instruction to teach this specific unit.

In all of the specified treatments, the unit on plant identification was not to comprise the full amount of instruction for the two week treatment period, but was to be used as a competency based unit in addition to information covered on plant culture, propagation, horticulture occupations, or other areas in ornamental horticulture deemed important by the instructor.

Collection of Data

Several evaluations were used to gather data on both the experimental and control groups. These measurements consisted of a written pretest, an identification pretest, a written posttest, an identification posttest, a student survey questionnaire, and a school survey questionnaire.

Written pretest

To assess student progress up to the point just prior to the study, a 50-item test (Appendix C) measuring general horticulture knowledge was given preceding the introduction of the treatment. This pretest was to provide an index of each student's ability in both experimental and control sections. The pre- and posttest questions were field tested with 96

students who were enrolled in horticulture classes at five Iowa high schools offering instruction in horticulture. An item analysis of the written pretest revealed a coefficient of reliability of .82.

Identification pretest

To measure prior student knowledge of plant material, an identification pretest (Appendix E) was administered to all groups. This pretest was composed of 20 plants randomly selected from the list of 50 ornamental plants.

Written posttest

A written posttest (Appendix D) composed of 25 multiple-choice questions was administered after completion of instruction. These questions dealt with plant anatomy, horticultural terms, and specific plants covered during the instructional period. An item analysis of the written posttest revealed a coefficient of reliability of .81.

Identification posttest

The identification posttest (Appendix E) was administered to measure gain in students' ability to identify ornamental plants. The test was administered at the end of the two week treatment period and consisted of 20 plants randomly selected from the 50 comprising the research list.

Student survey

A questionnaire was utilized to gather demographic data about students participating in the study (Appendix F). This information included grade level, sex, previous education, level of achievement, and future plans.

Special attention was made to identify the amount of time students spent learning common plant names in each treatment. These data would be used as an independent variable in regression analysis.

Instructor survey

Each of the eight instructors providing the instructional phase of this study was surveyed to gather data about teaching tenure, numbers of students, and his horticultural program (Appendix G). This information was used in the multiple regression analysis in attempting to identify factors associated with student achievement.

Analyses of Data

The design selected for use in this study was the nonequivalent control group design described by Campbell and Stanley (7). They give the following explanation about the application of this design (7, p. 47).

One of the most widespread experimental designs in educational research involves an experimental group and a control group both given a pretest and a posttest, but in which the control group and the experimental group do not have pre-experimental sampling equivalence. Rather, the groups constitute naturally assembled collectives such as classrooms, as similar as availability permits, but yet not so similar that one can dispense with the pretest. The assignment of X to one group or the other is assumed to be random and under the experimenter's control.

$$\begin{array}{ccc} 0 & X & 0 \\ \hline 0 & X & 0 \end{array}$$

. . . The more similar the experimental and control groups are in their recruitment, and the more this similarity is confirmed by the scores on the pretest, the more effective this control becomes.

The randomness of this experiment was limited to the random assignment of treatment to six of the eight schools. The mean scores of the

schools were used in analyzing the data. The data gathered from the schools were coded and recorded on IBM cards. Analyses were conducted at the Iowa State Computation Center. Statistical methods used in analyzing the data included analysis of variance, analysis of covariance, stepwise regression, product-moment correlation and correlated t-test.

The raw scores for the written pre- and posttest and identification pre- and posttest were converted to standard scores. The principal difficulty in reporting test results as raw scores is that point differences in raw scores do not have the same meaning over all parts of the range of scores. Converting the scores to percentages or percentiles does not in any way improve the interval problem.

For purposes of analysis, the written test scores were converted to T scores where $T = 100z + 500$. The mean of these standardized scores is 500 with a standard deviation of 100. The identification test scores were converted by means of a normal deviate transformation with a mean of 2.33 and a standard deviation of ± 1.00 . In the reporting of these data standard scores were utilized in the discussion of the findings.

The analysis of variance model used in this study to analyze the differences among treatment and control school means for the pretest and posttest mean scores was as follows:

$$Y_{ij} = \mu + \alpha_i + \epsilon_{ij}$$

where:

Y_{ij} = the pretest, posttest or gain measurement of the j th school within the i th treatment,

μ = the pretest, posttest or gain overall grand mean,
 α_i = effect of the i th treatment,
 ϵ_{ij} = effect due to random error,
 $i = 1, 2, 3, 4$ and
 $j = 1, 2.$

The model used in the analysis of covariance was as follows:

$$Y_{ij} = \mu + \alpha_i + B_1(X_{ij} - \bar{X}_{..})$$

where:

Y_{ij} = the pretest, posttest or gain measurement of the j th
 school within the i th treatment,
 μ = the pretest, posttest or gain overall grand mean,
 α_i = effect of the i th treatment,
 B_1 = regression coefficient,
 X_{ij} = covariate measurement of the j th school within the
 i th treatment,
 $\bar{X}_{..}$ = covariate grand mean,
 ϵ_{ij} = effect due to error,
 $i = 1, 2, 3, 4$ and
 $j = 1, 2.$

To aid in accounting for the variation in the mean posttest scores, a stepwise regression analysis was introduced. The model used in this analysis was as follows:

$$Y_{ij} = B_0 + B_1\bar{X}_1 + B_2\bar{X}_2 + \dots B_k\bar{X}_k + \epsilon_{ij}$$

where:

Y_{ij} = the posttest or gain measurement of the j th school
within the i th treatment,

B_0 = Y intercept or the height of the regression line at
the origin,

B_1, B_2, \dots, B_k = regression coefficients,

X_1, X_2, \dots, X_k = independent variables used to predict posttest or gain
scores,

ϵ_{ij} = effect due to error,

$i = 1, 2, 3, 4,$

$j = 1, 2$ and

$k = 1, 2, \dots, 17.$

Intercorrelations of student, school, program and teacher variables were analyzed through the use of product-moment correlation. Those variables that were related to student test scores were identified and discussed.

Differences between pretest mean scores and posttest mean scores were identified through the use of a correlated t-test. The formula for this analysis was as follows:

$$t = \frac{\bar{X}_{\text{pretest}} - \bar{X}_{\text{posttest}}}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2} - 2r \left(\frac{s_1}{\sqrt{N_1}} \right) \left(\frac{s_2}{\sqrt{N_2}} \right)}}$$

FINDINGS AND DISCUSSION

The main thrust of this study was to determine the effectiveness of selected teaching methods in the instruction of a unit on ornamental plant identification taught to horticulture classes at the secondary level. These techniques consisted of audio-tutorial instruction, filmstrip and script, greenhouse facilities, and lecture-discussion (control). Through a review of schools that met established criteria, eight programs were selected that represented what was felt to be exemplary programs in horticulture in the state of Iowa. Six of these schools were randomly assigned three of the four techniques used, while two were automatically assigned utilization of greenhouse facilities due to their established use of this method. Of the six schools who reported they had some type of growing structure to which they had access, only these two indicated they had available the plant material which is listed in Appendix A.

Since complete randomization of program selection and treatment assignment were not possible, generalizations of results should be made with caution beyond this sample group. However, an underlying assumption of this study is that these programs are reflective of current horticulture classes in Iowa at the secondary school level and future programs in many cases will follow the same general curriculum pattern.

In reporting the findings, the discussion will be divided into two parts. The first part will deal with a descriptive analysis of student, program and school variables. Part two will be an inferential analysis and will be concerned primarily with student achievement and related factors.

Descriptive Analysis

When nonequivalent groups are utilized in a pretest-posttest, control group design as much similarity as possible should be established between the groups. In the descriptive analysis, similarities and differences will be revealed among the four groups that were a part of this study. Table 2 contains the number of students that participated in this study divided by method of instruction, school, grade level and sex. A total of 125 students was almost equally divided among the four treatments with 33 students in each the audio-tutorial, greenhouse facility and control groups, while the filmstrip method had a somewhat smaller number of 26 students.

When student grade level was examined, it was revealed that none of the treatments had freshmen students enrolled, while audio-tutorial had 27.3 percent sophomores, 48.5 percent juniors and 24.2 percent seniors. This compared to 65.4 percent sophomores, 1.7 percent juniors and 26.9 percent seniors that were in the filmstrip group. The greenhouse facility method contained 6.1 percent sophomores, 57.5 percent juniors and 36.4 percent seniors. The remaining method, control, was composed of 33.3 percent of the sophomore grade level, 33.3 percent juniors and 33.3 percent senior students.

In viewing these percentages, it was observed that the upperclassmen were fairly well evenly distributed within the four groups with the exception of the filmstrip treatment which was almost void of junior students and had a higher concentration of sophomore level students.

Table 2. Number, sex and grade level of students by technique and school

Technique	School	Grade level ^a				Sex		Total
		1	2	3	4	Male	Female	
Audio-tutorial	Estherville	0	0	15	8	5	18	23
	Waverly	0	9	1	0	8	2	10
Total		0	9	16	8	13	20	33
Filmstrip	Albia	0	10	2	3	4	11	15
	Mason City	0	7	0	4	6	5	11
Total		0	17	2	7	10	16	26
Greenhouse facility	Cresco	0	0	12	4	8	8	16
	Washington	0	2	7	8	6	11	17
Total		0	2	19	12	14	19	33
Control	Garnavillo	0	11	4	6	9	12	21
	Montezuma	0	0	7	5	8	4	12
Total		0	11	11	11	17	16	33
Grand total		0	39	48	38	54	71	125

^aGrade level 1 = freshman; grade level 2 = sophomore; grade level 3 = junior; grade level 4 = senior.

When the factor of sex was considered, it was found that 43.2 percent of the participants in this study were male and 56.8 percent were female. Traditionally the horticulture program has had more appeal to female students at the secondary level because of its alliance with the areas of art, indoor and outdoor beautification. Across the four treatment groups, the percentages of male and female students were closely distributed, with the range of male students being 18.5 percent for filmstrip to 31.5 percent for the control group. The female students ranged from 22.5 percent contained in both the filmstrip and control groups to 28.2 percent in the audio-tutorial group.

Students in the four treatment groups were asked to respond to the number of semesters of agriculture and the number of semesters of biology they had completed (Table 3).

Table 3. Means and standard deviations of the number of semesters of vocational agriculture and biology completed by technique

Technique	N	Semesters of agriculture		Semesters of biology	
		Mean	Standard deviation	Mean	Standard deviation
Audio-tutorial	33	2.39	2.06	1.55	0.97
Filmstrip	26	1.27	0.92	1.27	0.92
Greenhouse facility	33	1.91	1.96	1.88	0.93
Control	33	2.24	1.82	1.70	0.84

Even though 38.4 percent of these students were juniors and 30.4 were seniors, the highest mean number of semesters of agriculture completed was 2.39 by the audio-tutorial group. This can be explained in part by the fact only two of the eight vocational agriculture instructors considered their horticulture class as part of their ongoing vocational agriculture program. The remaining six instructors responded that their horticulture class was a separate course offering and therefore perhaps less vocationally oriented. Students would have a tendency to drop in and drop out of these programs.

The mean response for semesters of biology completed was similar for all groups. The greenhouse facility method reported the highest mean number completed with 1.88 semesters and the filmstrip technique the lowest with 1.27 semesters of biology completed.

Students were asked to report what they perceived to be the average grade they received in their vocational agriculture and biology course work. Table 4 contains the means and standard deviations of these grades by treatment group.

It may be observed from this table that the mean of 4.21 with a standard deviation of 0.78 for the audio-tutorial group was the highest mean grade reported for agriculture courses taken. The lowest mean, 3.18, was reported by the control group, with mean grades for filmstrip and greenhouse facilities following in between these two.

This same pattern was also evident in grades received in biology courses, as the audio-tutorial group again had the high mean grade of 4.04 with a standard deviation of 0.68. The control group reported the low

mean of 3.50 for grades received in biology with a standard deviation of 0.75.

Table 4. Means and standard deviations of grades received in vocational agriculture and biology by technique

Technique	N	Grades in agriculture ^a		Grades in biology ^a	
		Mean	Standard deviation	Mean	Standard deviation
Audio-tutorial	33	4.21	0.78	4.04	0.68
Filmstrip	26	3.52	0.79	3.68	0.82
Greenhouse facility	33	3.89	0.83	3.71	0.76
Control	33	3.18	0.77	3.50	0.75

^aGrade of A = 5.0; grade of B = 4.0; grade of C = 3.0; grade of D = 2.0; grade of F = 1.0.

From casual observation of these means, it would appear the audio-tutorial treatment group had a slight advantage academically, although conclusive evidence of this factor cannot be established from this data.

The data in Table 5 reveals the residence of students grouped by technique used and by school. Overall, students were almost equally divided between rural and urban residence with 48.0 percent of the students living in town and 47.2 percent living on farms. The remaining 4.8 percent lived in dwellings on less than ten acres of land.

When teaching methods were compared, it was found that the audio-tutorial method had the highest percentage of urban students with 35.1

Table 5. Residence of students grouped by school and by technique

Technique	School	Residence ^a			Total
		Town	Acreage	Farm	
Audio-tutorial	Estherville	17	1	5	23
	Waverly	4	2	4	10
Total		21	3	9	33
Filmstrip	Albia	7	0	8	15
	Mason City	10	1	0	11
Total		17	1	8	26
Greenhouse facility	Cresco	4	1	11	16
	Washington	10	0	7	17
Total		14	1	18	33
Control	Garnavillo	4	0	17	21
	Montezuma	4	1	7	12
Total		8	1	24	33
Grand total		60	6	59	125

^aTown = urban population; acreage = dwelling on less than ten acres; farm = dwelling on ten acres or more.

percent and the control group had the lowest percentage with 13.3 percent of the urban students. This compares to 28.3 percent for the filmstrip technique and 23.3 percent for the greenhouse facility group.

In terms of rural residence, the control group had the highest number of rural students with 40.6 percent, while the filmstrip method contained the lowest with 13.6 percent. The remaining rural students were in the audio-tutorial method with 15.3 percent and the greenhouse facility group with 30.5 percent.

Students were also asked if they were employed in a horticultural related work experience program or worked part-time in a horticultural related occupation. Their responses basically supported previous findings that the horticulture classes in which these students were enrolled were not generally vocationally oriented as only 13 students or 10.4 percent said yes they were employed, while 112 or 89.6 percent responded that they did not work in a horticulturally related occupation. Of the 13 that responded affirmatively, six were in the filmstrip method of instruction, while the remaining seven were evenly distributed among the other three treatments.

When asked about their future plans, 36 students or 28.8 percent indicated they planned to continue their education in a four-year college or university upon graduation from high school. Another 40 students, 32.0 percent, reported that they planned to enter a two-year vocational-technical school upon graduation. This represents a combined total of 60.8 percent of the students participating in this study who planned to continue their education beyond high school. This compares to 44.1 percent of the students surveyed in a study by B. L. Byler, from the Agricultural Education Department at Iowa State University, titled, Analysis of Factors Related to the Educational Plans of Iowa Vocational Agriculture Students. However, in his study Byler sampled students in predominantly production agriculture classes, which would tend to account for differences in the educational aspirations of these students.

The remaining 39.2 percent of the students responding in this study indicated they planned to find immediate employment upon graduation from high school.

In examining between group responses, it was found that the majority of those students who planned to continue their education beyond high school were in the audio-tutorial and greenhouse facility groups with 23 and 24 students respectively reporting they planned to do so. The remaining 29 students were closely divided between the other two groups.

The control group had the greatest number of students, nineteen, who planned to find immediate employment upon graduation from high school. This was nearly twice as many as any other treatment group.

Those 76 students who had previously indicated they planned to receive additional education beyond high school were also asked if they perceived that they would obtain additional training in horticulture. Thirty-one or 40.8 percent of these students felt that they would seek some type of formal instruction in an area of horticulture once they left high school.

All of the 125 participating students were asked about their job preference once they completed their formal education. A surprising 48.8 percent of these students were as yet undecided in their future occupational plans. It should be pointed out that nearly 70 percent of these students were at the junior and senior grade level.

Another 28.0 percent reported they were definitely not interested in entering a horticultural occupation, while the remaining 23.2 percent indicated that they would prefer being employed in a horticultural related occupation.

The greatest number of undecided students were in the filmstrip method of instruction, which also had the highest number of sophomore

level students. A majority, 86.2 percent, of those students who indicated they preferred employment in a horticultural occupation were in the audio-tutorial and greenhouse facility groups with 15 and 10 students respectively.

When questioned about their reason for enrolling in the horticulture class they were attending, 79.2 percent of the students surveyed reported that they had selected this class as an elective because of their interest in horticulture. An additional 4.8 percent perceived the horticulture class as being part of their regular vocational agriculture program. Even though two of the eight vocational agriculture instructors in this study perceived their horticulture curriculum as being part of their regular vocational agriculture program, a majority of their students did not view it as such.

The remaining 16.0 percent of the students questioned indicated they had no interest in horticulture, but due to scheduling or other conflicts found themselves enrolled in this class. It should be pointed out that of this percentage, 10.4 percent were in the control group.

School, teacher and program variables

Selected school, teacher and program variables were examined to determine similarities or differences between groups. The data in Table 6 presents information about teaching tenure, instructor background training in horticulture and estimated dollar value invested in their respective horticulture programs.

It is revealed in Table 6 that the number of years teaching in the present school system by the horticulture instructor was nearly equal for

Table 6. Number of years participating vocational agriculture instructors have been teaching, number of quarter hour credits of horticulture completed, and dollar value of horticulture program by school and by technique

Technique	School	Dollar value of horticulture program	Years teaching		Credits in horticulture
			Present system	Total number	
Audio-tutorial	Estherville	350.00	4	4	5
	Waverly	325.00	7	7	3
Total		675.00	11	11	8
Filmstrip	Albia	300.00	4	4	5
	Mason City	400.00	9	12	16
Total		700.00	13	16	21
Greenhouse facility	Cresco	15,000.00	7	24	30
	Washington	9,500.00	3	3	38
Total		24,500.00	10	27	68
Control	Garnavillo	600.00	2	2	0
	Montezuma	220.00	8	8	0
Total		820.00	10	10	0

the four treatment groups. However, when total number of years teaching experience were compared, it became apparent the greenhouse facility method represented over twice as many years teaching experience as the audio-tutorial and control groups, while it had 68.8 percent more years teaching than the filmstrip method.

When credits earned in horticulture by the instructor were examined, the same pattern appeared as the greenhouse facility method represented a total of 68 credits, while there were only a total of 16 for the filmstrip technique, eight for the audio-tutorial method and none taken by the control group. This outcome would be expected since the greenhouse facility instructional method had more time and money invested in its horticulture program.

The money invested aspect is also readily apparent as the combined total estimated dollar value of the greenhouse facility method was \$24,500.00. The greatest portion of this investment is in the greenhouse structure and equipment which of course the other treatment groups do not have. The combined estimated dollar value for the other groups were similar and averaged approximately \$732.00.

Time invested in the horticulture program also conformed with the teaching experience, credits earned in horticulture and money invested, as each of the two schools in the greenhouse facility method offered two semesters of horticulture, while the remaining six schools offered one semester each. However, it should also be pointed out that the Cresco vocational agriculture department, included in the greenhouse facility method, had three teachers employed in their program while three of the

remaining seven schools were two-teacher departments and four were single-teacher departments.

The treatments involved in this study were also compared on the basis of program enrollment and school enrollment. In Table 7 the combined number of students enrolled in the total vocational agriculture program are given. These totals range from a low of 180 students for the control group to 292 for the combined total in the audio-tutorial method. Further analysis of this variable is presented in Table 9b.

Table 7. Student enrollment in vocational agriculture program and senior high school by school and by technique^a

Technique	School	Program enrollment	School enrollment
Audio-tutorial	Estherville	202	730
	Waverly	90	900
	Total	292	1630
Filmstrip	Albia	98	640
	Mason City	110	1500 ^b
	Total	208	2140
Greenhouse facility	Cresco	176	700
	Washington	88	700
	Total	264	1400
Control	Garnavillo	120	180
	Montezuma	60	215
	Total	180	395

^aGrades nine, ten, eleven and twelve.

^bGrades ten, eleven and twelve only.

In terms of school enrollment, the control group again represented the lowest number with a combined total of 395 students in the top four grades. The filmstrip method was the group with the highest school enrollment with 2140 even though one school in this group reported the number of students in the upper three grades as constituting the senior high school. This factor will also be reviewed in correlation analysis.

To further assess the horticulture programs under study, the vocational agriculture instructors were asked to indicate which topic areas in addition to ornamental floriculture they included as part of their instruction (see Appendix G).

It was found that all eight schools provided instruction in landscape establishment and maintenance and turf establishment and maintenance, while seven of the eight programs offered instruction in small fruit production and vegetable production. Six schools also included arboriculture and tree fruit production, while only one program indicated they taught about nursery production.

No attempt was made to assess the amount of information presented in these topic areas, but in relation to the instructors' background training one would be led to assume that, in most cases, the depth of instruction would be limited.

Various units of instruction in ornamental floriculture were presented to the vocational agriculture instructor in each school. In reviewing his horticulture curriculum, the instructor determined the number of weeks each unit was taught within his program. For purposes of indicating the level of importance placed on these units by the instructor, the number of

weeks reported by each school were totaled together for a composite reference along with means and standard deviations. Table 8 contains the names of the instructional units, total and mean weeks each unit is taught by the eight schools.

Table 8. Instructional units in ornamental floriculture, combined total and mean weeks taught by participating schools

Unit of instruction	Weeks taught		
	Combined	Mean	Standard deviation
Occupational opportunities in ornamental horticulture	8.0	1.0	0.61
Ornamental horticulture salesmanship and selling	0.0	0.0	0.00
Employability skills and human relations	0.0	0.0	0.00
Hand and power tools and hardware used in ornamental horticulture	4.0	0.5	0.36
Planting media and its preparation	14.0	1.8	0.97
Greenhouse plant propagation	11.5	1.4	0.98
Fertilization of floral plants	5.0	0.6	0.42
Maintaining desirable environmental conditions in the greenhouse	6.0	0.8	0.50
Insect and disease control in the greenhouse	4.5	0.6	0.46
Operation and care of small gasoline engines	0.0	0.0	0.00
Arranging and designing with flowers, plants and decorative materials	7.0	0.9	1.03
Identification and selection of plant material	14.0	1.8	0.71

In reviewing the reported number of weeks in which various instructional units were taught, it becomes apparent that three areas of instruction were more predominate than others. The units involving planting media and plant identification were each taught for a combined total of 14 weeks by the eight schools. In both of these areas, the number of weeks per school was fairly evenly divided among the eight participants.

Although only two schools had greenhouse facilities, the eight programs combined for a total of 11.5 weeks of instruction in greenhouse propagation. In a breakdown of this total, again the schools were in close agreement as to the length of instruction, as one school taught this unit three weeks, three schools for a period of two weeks, another for one and one-half weeks, one school for a one week period and two schools did not include this particular unit.

When asked about their interest in receiving inservice education involving technical areas of horticulture, all eight vocational agriculture instructors were strongly affirmative in their request for assistance in this area. It was generally felt these inservice programs required technical practitioners to provide the type of additional training needed by secondary teachers in vocational programs.

Relationship of student, program and instructor variables to pretest and posttest achievement scores

Students' responses to certain items on the ornamental horticulture questionnaire (Appendix F) and teachers' responses to selected items on the program and teacher inventory (Appendix G) were correlated with students' standard scores on the pre- and posttests administered to the students.

Since product-moment correlation was used to determine correlation coefficients, only correlations between continuous variables will be discussed at this point. Although dichotomous and categorical variables are included in the correlation matrix, their interpretation cannot be included under this technique.

The correlation coefficients calculated for the selected variables under investigation are presented in Table 9b. It was disclosed that the scores from the four tests administered were highly intercorrelated. A correlation coefficient of .37 was observed for the relationship between written pretest scores and plant identification pretest scores. This correlation coefficient is significant at the .001 level of probability. It may be concluded that students who received high scores on the written pretest also received high scores on the identification pretest.

It was determined that a significant ($P < .001$) correlation coefficient of .67 existed for the relationship between written posttest scores and plant identification posttest scores. This relationship indicated that students who received high scores on the written posttest also received high scores on the identification posttest.

Table 9a. Variable identification for correlation matrix

Matrix variable	Description
1	Written pretest score.
2	Plant identification pretest score.
3	Written posttest score.
4	Plant identification posttest score.
5	Semesters of vocational agriculture completed.
6	Grades received in vocational agriculture.
7	Semesters of biology completed.
8	Grades received in biology.
9	Place of residence.
10	Future plans upon graduation from high school.
11	Whether or not the student will seek additional training in horticulture.
12	Reason for enrolling in the ornamental horticulture class.
13	Amount of time the student spent learning the common names of ornamental plants.
14	Total number of years the vocational agriculture instructor has been teaching.
15	Number of years the vocational agriculture instructor has been teaching in his present school system.
16	Number of students enrolled in the horticulture class.
17	Number of students enrolled in the total vocational agriculture program.
18	Number of students attending the high school in which the horticulture class is being taught.
19	Dollar value invested in the horticulture program.
20	Number of quarter hour credits the vocational agriculture instructor has earned in horticulture.

Table 9b. Intercorrelations among student, teacher, and school variables, and student test scores^a

Variables	1	2	3	4	5
1					
2	.37***				
3	.68***	.36***			
4	.54***	.51***	.67***		
5	-.06	-.11	-.15	-.17	
6	.28**	.21*	.24**	.21*	.30***
7	.39***	.25*	.26**	.15	-.04
8	.38***	.39***	.32***	.28**	-.07
9	-.22*	-.13	-.26**	-.23*	.28**
10	-.51***	-.40***	-.55***	-.45***	.03
11	-.38***	-.38***	.41***	-.32***	.07
12	-.35***	-.27**	-.50***	-.43***	.17
13	.02	.13	.20*	.26**	-.15
14	.18*	-.03	.36***	.46***	-.05
15	.05	.01	.34***	.33***	-.06
16	.18*	.17	-.11	-.06	.01
17	.36***	.30***	.27**	.44***	-.02
18	.44***	.32***	.52***	.68***	-.08
19	.28**	-.17	.26**	.33***	-.03
20	.42***	-.06	.34***	.43***	-.07

^aThese variables are described by variable number in the variable identification preceding this matrix.

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

***Significant at the .001 level of probability.

6	7	8	9	10	11	12
.19*						
.25**	.82***					
.03	-.08	-.12				
-.27**	-.30***	-.39***	.18*			
-.11	-.21*	-.31***	.17	.50***		
-.18*	-.17	-.26**	.27**	.25**	.28**	
-.09	-.06	.03	-.13	-.08	-.18*	-.25*
.04	.08	.09	.06	-.07	.01	-.25*
-.03	-.16	-.08	-.14	-.03	-.14	-.23*
.22*	.35***	.31***	.02	-.15	.03	.08
.37***	.29**	.34***	-.10	-.29**	-.09	-.23*
.02	-.07	-.01	-.39***	-.29**	-.26**	-.36***
-.03	.18*	.09	.12	-.09	.11	-.14
-.11	.15	.06	-.06	-.18	-.01	-.16

	11	12	13	14	15	16	17	18
.28**								
-.18*		-.25*						
.01		-.25*	.02					
-.14		-.23*	.37***	.67***				
.03		.08	-.37***	-.38***	-.78***			
-.09		-.23*	-.19*	.27**	-.13	.65***		
-.28**		-.36***	.41***	.31***	.53***	-.39***	.15	
.11		-.14	-.16	.68***	.09	-.01	.18*	.07
-.01		-.16	.04	.43***	.07	-.07	.02	.36

14	15	16	17	18	19	20
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±	.67***					
*	-.38***	-.78***				
	.27**	-.13	.65***			
*	.31***	.53***	-.39***	.15		
	.68***	.09	-.01	.18*	.07	
	.43***	.07	-.07	.02	.36***	.87***

A correlation coefficient of .68 was disclosed for the relationship between written pretest scores and written posttest scores. This correlation was significant at the .001 level of probability. Therefore, students achieving high scores on the written pretest also achieved high scores on the written posttest.

A correlation coefficient of .51 was revealed for the relationship between plant identification pretest scores and plant identification posttest scores. This correlation coefficient was found to be significant at the .001 level of probability. Consequently, it may be concluded that students who scored higher on the identification pretest also scored higher on the posttest for plant identification.

It was determined that a significant ($P < .001$) correlation coefficient of .30 existed for the relationship between the number of semesters of vocational agriculture students had completed and the grades received in vocational agriculture. It was observed from this analysis that students who completed more semesters of agriculture generally received higher grades in this subject.

A correlation coefficient of .39 was calculated for the relationship between number of semesters of biology completed by students and scores achieved on the written pretest. This correlation coefficient is significant at the .001 level of probability. Therefore, it was suggested that students who had completed a greater number of semesters of biology also achieved higher pretest scores on written test questions in horticulture.

The grades students received in biology were correlated with scores obtained on the written horticulture pretest. This correlation analysis yielded a coefficient of .38 which is significant at the .001 level of probability. This analysis indicated that students who received higher grades in biology also received higher scores on the written pretest.

A significant correlation of .39 was determined for the relationship between grades received in biology and plant identification pretest scores. This correlation coefficient was found to be significant at the .001 level of probability. It was observed that students who earned higher grades in biology tended to achieve higher scores on the identification pretest.

When grades received in biology were correlated with written posttest scores, a significant ($P < .001$) correlation coefficient of .32 was disclosed. It was indicated by the analysis of this relationship that students who achieved higher biology grades generally scored higher on the written posttest questions.

A correlation coefficient of .82 was calculated for the relationship between grades received in biology and the number of semesters of biology students completed. This correlation coefficient is significant at the .001 level of probability. This relationship would indicate that students who received higher grades in biology also completed more semesters of this course.

Contrary to results reported by Barry et al. (1), an analysis of the relationship between the amount of time spent learning common plant names and students' scores on the plant identification posttest revealed a

significant ($P < .01$) correlation coefficient of .26. It was observed that students who spent a greater amount of time learning the names of ornamental plants tended to score higher on the plant identification posttest. Barry's results were obtained from the use of a slide-audio tape instructional program for a college level chemistry course. He found that achievement on posttest evaluation was essentially uncorrelated with hours of study.

The analysis of correlation for the relationship between scores earned on the written posttest and total number of years the vocational agriculture instructor had been teaching yielded a correlation coefficient of .36. This correlation coefficient was significant at the .001 level of probability. Also, the correlation between scores achieved on the plant identification posttest and total number of years the vo-ag instructor had been teaching revealed a significant ($P < .001$) correlation coefficient of .46. These two analyses suggested that there was a relationship between student achievement and teacher tenure and that students tended to achieve higher scores on posttest evaluation where the teacher possessed the greatest number of years teaching experience.

A correlation coefficient of .34 was determined to exist for the relationship between students' written posttest scores and number of years the vocational agriculture instructor had been teaching in his present school system. This correlation coefficient is significant at the .001 level of probability. Thus, it may be concluded that a relationship exists between these two variables.

The analysis of the relationship between students' scores on the identification posttest and the vocational agriculture teacher's tenure in his present school system revealed a significant ($P < .001$) correlation coefficient of .33. From this and the previous analysis, it may be concluded that there was a relationship between posttest achievement and teacher tenure in his present teaching position. This indicates students were able to achieve higher scores on posttest criteria when teachers had a greater number of years teaching experience in their present school system.

A significant correlation coefficient of .36 was calculated for the relationship between students' written pretest scores and student enrollment in the vocational agriculture program. This correlation coefficient was significant at the .001 level of probability. It was concluded that students enrolled in large vocational agriculture programs tended to achieve higher written pretest scores.

Students' plant identification pretest scores were correlated with size of vocational agriculture programs. This analysis disclosed a correlation coefficient of .30 which is significant at the .001 level of probability. This analysis indicated that students from schools with large enrollments in vocational agriculture tended to achieve higher scores on the plant identification pretest evaluation.

A correlation analysis for students' plant identification posttest scores and number of students enrolled in the vocational agriculture programs revealed a correlation coefficient of .44. This correlation coefficient was significant at the .001 level of probability. It was observed

that students from programs with high enrollments were generally able to achieve higher identification posttest scores.

A significant correlation of .65 was calculated for the relationship between the number of students enrolled in horticulture and the total number of students enrolled in the vocational agriculture program. This correlation coefficient was significant at the .001 level of probability. This analysis indicated that departments with large enrollments tended to have more students enrolled in their ornamental horticulture course offering.

The analysis of the relationship between students' written pretest scores and high school enrollment yielded a significant ($P < .001$) correlation coefficient of .44. Students in schools with high enrollments tended to score higher on the written horticulture pretest.

It was determined that a correlation coefficient of .52 existed between the scores students received on written posttest questions and student enrollment in senior high school. This correlation coefficient was significant at the .001 level of probability. This analysis suggested that students who attended high schools with large enrollments tended to achieve higher scores on the written posttest.

A significant ($P < .001$) correlation coefficient of .68 was disclosed for the relationship between students' identification posttest scores and number of students enrolled in senior high school. Thus, it may be concluded that students who scored high in plant identification were more apt to be from schools with large enrollments.

The analysis of the relationship between students' identification posttest scores and dollar value of the horticulture program disclosed a correlation coefficient of .33 which was significant at the .001 level of probability. Consequently, it may be concluded that a relationship exists between students' plant identification posttest scores and dollar value of the horticulture program. Those programs that reported a greater investment generally had students who scored higher on the identification posttest.

It was determined that a correlation coefficient of .68 existed for the relationship between the total number of years the vocational agriculture instructors had been teaching, and the amount of money invested in the schools' horticulture programs. This correlation coefficient was significant at the .001 level of probability and indicated those teachers having the most teaching experience also had programs with a greater dollar investment.

A significant ($P < .001$) correlation coefficient of .42 was revealed for the relationship between students' written pretest scores and credits earned in horticulture by the vocational agriculture instructor. It was observed that instructors who had acquired a greater number of credits in horticulture tended to have students who scored higher on the written pretest examination.

The correlation analysis for the relationship between students' written posttest scores and credits earned in horticulture by the instructor yielded a correlation coefficient of .34 which was significant at the .001 probability level. It was concluded that instructors who had a

greater number of credits in horticulture also had students who generally scored higher on the written posttest.

A correlation coefficient of .43 was calculated for the relationship between students' plant identification posttest scores and the number of horticulture credits obtained by the vocational agriculture instructor. This correlation coefficient was significant at the .001 level of probability. It was indicated that a relationship exists between students' performances on plant identification posttest evaluation and credits earned in horticulture by the instructor. Those teachers with a greater number of horticulture credits tended to have students who achieved higher on the identification posttest.

A significant ($P < .001$) correlation of .87 was observed for the relationship between dollar value invested in the horticulture programs and the number of credits in horticulture possessed by the vocational agriculture instructor. It was concluded that those programs with the highest investment also employed the instructors with the greatest number of horticulture credits.

Inferential Analysis

The analyses of the pretest and posttest measures were utilized along with the descriptive analyses to meet the objectives of this study, which were, (1) determine the effectiveness of instructional media in teaching the common names of ornamental plants, (2) determine those factors related to achievement in horticulture when instructional media is used, and (3) determine the implications for the use of instructional media in horticulture programs.

The analysis of this data was based on the testing of several null hypotheses. The first hypothesis stated was:

H_{0_1} : There is no difference between the treatment groups and control group as measured by the written horticulture pretest.

Written pretest mean scores and standard deviations by technique are listed in Table 10. The audio-tutorial group had a mean score of 529.24 with a standard deviation of 77.87. This compared to a mean of 487.35 (standard deviation - 77.87) for the filmstrip method, and a mean score of

Table 10. Means and standard deviations of written pretest scores by technique

Technique	N	Mean	Standard deviation
Audio-tutorial	33	529.24	77.87
Filmstrip	26	487.35	110.69
Greenhouse facility	33	552.12	64.42
Control	33	437.52	95.58

552.12 with a standard deviation of 64.42 for the greenhouse facility treatment. The control group had a written pretest mean score of 437.52 with a standard deviation of 95.58. It should be pointed out these means were standardized T scores and their derivation was previously described.

An analysis of variance of the difference between these means revealed an F-value of 0.94 which was not significant. This data, presented in Table 11, failed to reject the first null hypothesis.

Table 11. Analysis of variance of written pretest scores by groups

Source of variation	d.f.	S.S.	M.S.	F-value
Regression	3	15917.37	5305.79	0.94
Error	4	22590.01	5647.50	
Total	7	38507.38		

The second hypothesis dealt with the plant identification pretest.

It stated:

H_{02} : There is no difference between treatment groups and control group as measured by the ornamental plant identification pretest.

The means and standard deviations listed by technique for this variable are given in Table 12. These means were a result of a normal deviate transformation rather than percentage scores.

Table 12. Means and standard deviations of plant identification pretest scores by technique

Technique	N	Mean	Standard deviation
Audio-tutorial	33	184.39	46.82
Filmstrip	26	200.54	33.76
Greenhouse facility	33	160.61	48.55
Control	33	158.33	31.39

The data collected resulted in a mean identification pretest score of 200.54 with a standard deviation of 33.76 for the filmstrip group which was the high treatment mean. The means for the audio-tutorial and greenhouse facility methods were 184.39 and 160.61 with standard deviations of 46.82 and 48.55 respectively. These mean scores compared to the mean score of 158.33 (standard deviation - 31.39) for the control group.

The analysis of variance between these means yielded an F-value of 1.27 which was not significant (Table 13). This analysis failed to reject H_0 which was: There is no difference between treatment groups and control group as measured by the ornamental plant identification pretest.

Table 13. Analysis of variance of plant identification pretest scores by groups

Source of variation	d.f.	S.S.	M.S.	F-value
Regression	3	2790.23	930.08	1.27
Error	4	2940.96	735.24	
Total	7	5731.19		

From these analyses, it may be concluded that treatment groups and control group were statistically equivalent in their knowledge of horticulture and ornamental plants at the beginning of this study. Since complete randomization was not possible, the factor of pretest equivalence had to be established.

To determine the effectiveness of each of these methods in teaching horticultural information, a written posttest with 25 test items was administered to each group. In order to identify differences between these techniques, a third null hypothesis was tested. This hypothesis stated:

H_{0_3} : There is no difference between treatment groups and control group as measured by the written horticulture posttest.

Written posttest scores and standard deviations by technique are presented in Table 14. The highest mean score, 540.76 with a standard deviation of 68.75, was determined for the greenhouse facility group. The control group received the lowest mean score of 426.52 (standard deviation - 85.94) on the written posttest. The means for audio-tutorial and filmstrip method of instruction were 526.37 (standard deviation - 93.30) and 515.00 (standard deviation - 109.67) respectively.

Table 14. Means and standard deviations of written posttest scores by technique

Technique	N	Mean	Standard deviation
Audio-tutorial	33	526.33	93.30
Filmstrip	26	515.00	109.67
Greenhouse facility	33	540.76	68.75
Control	33	426.52	85.94

Table 15 contains the analysis of variance of the difference between these means. This analysis disclosed an F-value of 1.41 which was not significant. These data failed to reject H_{o_3} which was: There is no difference between treatment groups and control group as measured by the written horticulture posttest.

Table 15. Analysis of variance of written posttest scores by groups

Source of variation	d.f.	S.S.	M.S.	F-value
Regression	3	15410.14	5136.71	1.41
Error	4	14573.68	3643.42	
Total	7	29983.82		

The next hypothesis, dealing with ornamental plant identification posttest, was:

H_{o_4} : There is no difference between treatment groups and control group as measured by the ornamental plant identification posttest.

The data gathered involving this hypothesis was scored and tabulated in Table 16. The calculated means and standard deviations are listed by technique.

It can be observed from Table 16 that the mean of 329.54 (standard deviation - 67.29) for the filmstrip technique was the highest mean recorded, while the mean score of 173.52 with the standard deviation of 34.36 for the control group was the lowest mean reported. The mean scores

Table 16. Means and standard deviations of plant identification posttest scores by technique

Technique	N	Mean	Standard deviation
Audio-tutorial	33	291.42	75.02
Filmstrip	26	329.54	67.29
Greenhouse facility	33	315.36	69.79
Control	33	173.52	34.36

for audio-tutorial and greenhouse facility methods fell between these two with means of 291.42 (standard deviation - 75.02) and 315.26 (standard deviation - 69.79) respectively.

When these mean scores were used in the analysis of variance, as shown in Table 17, the F-value that resulted was 3.41, which was not significant. However, this F-value did approach the .10 significance level and it may be concurred that there was some difference present in the means recorded on the plant identification posttest, although it was not statistically evident.

Table 17. Analysis of variance of plant identification posttest scores by groups

Source of variation	d.f.	S.S.	M.S.	F-value
Regression	3	32258.15	10752.72	3.41
Error	4	12632.10	3158.02	
Total	7	44890.25		

Since analyses of posttest scores for the groups involved in this study did not disclose any significant differences, an examination of gain scores for each treatment was conducted.

Differences between the plant identification pretest and posttest indicated a distinct increase in scores for the four groups (Table 18). The mean gain scores ranged from 15.18 (standard deviation = 33.41) to 154.76 with a standard deviation of 62.41. From general observation, it would appear the greenhouse facility technique experienced the greatest increase in scores, and superficially would be the better of the four methods used to teach plant identification.

Table 18. Mean gain scores and standard deviations for scores between plant identification pretest and plant identification posttest by technique

Technique	N	Mean difference	Standard deviation
Audio-tutorial	33	107.03	56.81
Filmstrip	26	129.00	58.03
Greenhouse facility	33	154.76	62.41
Control	33	15.18	33.41

The data in Table 19 supports the previous findings by revealing a significant ($P < .001$) t-value for the difference between the plant identification pretest and posttest scores for three of the four groups, while a significant t-value at the .01 level of probability was determined for the remaining technique. It was also revealed in Table 19 that there were no significant gains on the written measurements in any of the four groups.

Table 19. T-test analysis of gain scores between written and plant identification pretests and written and plant identification posttests by technique

Technique	N	Type of measurement	t-value
Audio-tutorial	33	Written test	0.21
		Identification test	10.82***
Filmstrip	26	Written test	1.93
		Identification test	11.33***
Greenhouse facility	33	Written test	0.89
		Identification test	14.75***
Control	33	Written test	0.73
		Identification test	2.61**

**Significant at the .01 level of probability.

***Significant at the .001 level of probability.

Thus, neither of these four methods were able to increase student achievement on written knowledge during the instructional phase of this study.

It was felt that if selected variables were adjusted for their influence on the posttest analyses, significant differences would be revealed between posttest means. The stepwise regression analysis was employed to identify variables that could be used as covariates in this adjustment procedure.

Those variables which might affect the written posttest scores are identified in Table 20.

Table 20. Covariates identified by stepwise regression for written post-test scores

Step	Variable	R ²
1	Number of students in senior high school	0.739
2	Dollar value of horticulture program	0.883
3	Grade level	0.934

The analysis of covariance was employed to retest the null hypotheses previously stated respective to the posttest scores. When this procedure was used to test differences between written horticulture posttest means, shown in Table 21, an F-value of 5.25 was disclosed. This F-value with three and three degrees of freedom was not significant. However, it did approach significance at the .10 level of probability as the table F-value for this significance level is 5.39.

Table 21. Analysis of covariance for written posttest scores when student enrollment in senior high school was used as a covariate

Source of variation	d.f.	S.S.	M.S.	F-value
Covariate	1	11640.47	11640.46	
Regression	3	15410.14	5136.71	5.25
Error	3	2933.21	977.74	
Total	7	29983.82		

The next step in analysis was the use of the dollar value invested in the horticulture program as a covariate in the analysis of written posttest scores. An F-value of 1.17 which was not significant was calculated from this procedure (Table 22).

Table 22. Analysis of covariance for written posttest scores when dollar value of horticulture program was used as a covariate

Source of variation	d.f.	S.S.	M.S.	F-value
Covariate	1	1428.22	1428.22	
Regression	3	15410.14	5136.71	1.17
Error	3	13145.46	4381.82	
Total	7	29983.82		

The analysis of covariance for written horticulture posttest scores when student grade level was used as a covariate is shown in Table 23. This analysis yielded an F-value of 1.15 with three and three degrees of freedom which also was not significant.

Table 23. Analysis of covariance for written posttest scores when student grade level was used as a covariate

Source of variation	d.f.	S.S.	M.S.	F-value
Covariate	1	1195.20	1195.20	
Regression	3	15410.14	5136.71	1.15
Error	3	13378.48	4459.49	
Total	7	29983.82		

The stepwise regression technique was also used to determine variables related to the plant identification posttest scores. As shown in Table 24, it can be observed that the three variables identified account for over 91 percent of the variation in the identification posttest scores.

Table 24. Covariates identified by stepwise regression for plant identification posttest scores

Step	Variable	R ²
1	Number of students in senior high school	0.662
2	Grades received in biology	0.855
3	Dollar value of horticulture program	0.918

The variables listed in Table 24 were used as covariates in order to adjust for differences that may have affected the mean posttest scores for plant identification.

In the first analysis of covariance for plant identification posttest scores, shown in Table 25, student enrollment was utilized as a covariate resulting in an F-value of 3.70. This F-value was not significant. Therefore, there appeared to be no significant difference between the performances of the four treatment groups when the means of their plant identification posttest were compared after adjusting for student enrollment in senior high school.

Table 25. Analysis of covariance for plant identification posttest scores when student enrollment in senior high school was used as a covariate

Source of variation	d.f.	S.S.	M.S.	F-value
Covariate	1	3909.65	3909.65	
Regression	3	32258.15	10752.72	3.70
Error	3	8722.45	2907.48	
Total	7	44890.25		

When grades received in biology were adjusted through the use of analysis of covariance, it was determined by a resulting F-value of 7.15 that the means for the plant identification posttest were significantly different (Table 26). This F-value with three and three degrees of freedom was significant at the .10 level of probability.

Table 26. Analysis of covariance for plant identification posttest scores when grades received in biology were used as a covariate

Source of variation	d.f.	S.S.	M.S.	F-value
Covariate	1	8119.73	8119.73	
Regression	3	32258.15	10752.72	7.15 ^a
Error	3	4512.37	1504.12	
Total	7	44890.25		

^aSignificant at the .10 level of probability.

A Scheffé test, as described by Snedecor and Cochran (56), was used to determine where the difference or differences in the mean plant identification posttest scores occurred after adjusting for grades received in biology.

It was found by this procedure that the adjusted mean of 341.08 for the filmstrip method of instruction was significantly ($P < .10$) greater than the adjusted mean of 170.53 for the control group. As well, the adjusted means of 288.28 and 302.61 for the audio-tutorial and greenhouse facility methods, respectively, approached the .10 level of probability for being significantly greater than the mean of 170.53 for the control group.

The last covariate identified by the stepwise regression process for the analysis of plant identification posttest scores was dollar value invested in the horticulture program. When analysis of covariance was used, as shown in Table 27, for the examination of identification posttest scores, an F-value of 3.67 was revealed. This F-value was not significant.

Table 27. Analysis of covariance for plant identification posttest scores when dollar value of horticulture program was used as a covariate

Source of variation	d.f.	S.S.	M.S.	F-value
Covariate	1	3843.32	3843.32	
Regression	3	32258.15	10752.72	3.67
Error	3	8788.78	2929.59	
Total	7	44890.25		

In addition to those variables identified by the stepwise regression technique, the following variables were also utilized as covariates in adjusting for differences in variation between groups: pretest scores, time spent in learning plant names and number of credits earned in horticulture by the instructor. Of these, plant identification pretest scores, when used as a covariate, disclosed a significant F-value of 7.06 for the analysis of plant identification posttest scores (Table 28). This F-value was significant at the .10 probability level.

Table 28. Analysis of covariance for plant identification posttest scores when identification pretest scores were used as a covariate

Source of variation	d.f.	S.S.	M.S.	F-value
Covariate	1	8062.38	8062.38	
Regression	3	32258.15	10752.72	7.06 ^a
Error	3	4569.72	1523.24	
Total	7	44890.25		

^aSignificant at the .10 level of probability.

A post hoc analysis of group means with the Scheffé procedure revealed that the adjusted treatment mean of 336.66 for the greenhouse facility method was significantly ($P < .10$) greater than the adjusted mean of 202.11 for the control group. It was also disclosed that the adjusted means of 276.59 and 287.14 for the audio-tutorial and filmstrip methods, respectively, were not significantly different from the control group mean.

Selected comparisons were also made among the four groups examined in this study. The first comparison was established to detect differences between treatments and control on the written horticulture posttest. The data in Table 29 presents the analysis of variance conducted on this measurement. The resulting F-value of 4.12 with one and four degrees of freedom was not significant. Thus, from these data it was indicated that the mean scores on the written posttest for the treatment groups were not significantly greater than the control group.

Table 29. Analysis of variance of written posttest scores with comparison of treatments versus control

Source of variation	d.f.	S.S.	M.S.	F-value
Regression	3	15410.14		
C ₁ trt vs. control	1	15006.43	15006.43	4.12
Remainder	2	403.71		
Error	4	14573.68	3643.42	
Total	7	29983.82		

The same comparison was made with the plant identification posttest scores as shown in Table 30. The analysis of variance conducted yielded an F-value of 8.94 for this comparison which was found to be significant at the .05 level of probability. Further analysis revealed that plant identification posttest mean scores for the three treatment groups were significantly ($P < .01$) greater than the mean for the control. Thus, it may

be perceived from these data that students in any one of the treatment groups were able to achieve higher posttest scores than the students in the control group.

Table 30. Analysis of variance of plant identification posttest scores with comparison of treatments versus control

Source of variation	d.f.	S.S.	M.S.	F-value
Regression	3	32258.15		
C ₁ trt vs. control	1	28236.12	28236.12	8.94*
Remainder	2	4022.03		
Error	4	12632.10	3158.03	
Total	7	44890.25		

*Significant at the .05 level of probability.

A second comparison was made among posttest means that dealt with a media versus nonmedia approach. In Table 31 written horticulture posttest mean scores were compared between media and nonmedia users by using analysis of variance. The calculated F-value of 0.83 was not significant.

Table 31. Analysis of variance of written posttest scores with comparison of media treatments versus nonmedia treatments

Source of variation	d.f.	S.S.	M.S.	F-value
Regression	3	15410.14		
C ₂ media vs. nonmedia	1	3007.23	3007.23	0.83
Remainder	2	12402.91		
Error	4	14573.68	3643.42	
Total	7	29983.82		

Comparison two was also applied to the plant identification posttest mean scores (Table 32). The analysis of variance used in this procedure also yielded a nonsignificant F-value of 2.42.

Table 32. Analysis of variance of plant identification posttest scores with comparison of media treatments versus nonmedia treatments

Source of variation	d.f.	S.S.	M.S.	F-value
Regression	3	32258.15		
C ₂ media vs. nonmedia	1	7656.56	7656.56	2.42
Remainder	2	24601.59		
Error	4	12632.10	3158.02	
Total	7	44890.25		

It was indicated from this second comparison that in both the written portion and plant identification section of the evaluation procedure, that no difference was apparent in the performance of students when they were divided by this dichotomy.

An interest was expressed in the amount of time students reported that they spent during their unit on ornamental horticulture learning plant names. It was previously revealed in Table 9b that a relationship existed between the amount of time spent learning these names and students' plant identification posttest score.

Means and standard deviations are listed by technique in Table 33 for the number of minutes each group utilized for the purpose of learning names of ornamental plants.

Table 33. Means and standard deviations of amount of time in minutes students spent learning plant names by technique

Technique	N	Mean	Standard deviation
Audio-tutorial	33	241.83	96.61
Filmstrip	26	334.62	93.22
Greenhouse facility	33	221.82	75.72
Control	33	189.09	113.12

It was observed from this table that the filmstrip method reported the greatest amount of time spent with a mean of 334.62 minutes with a standard deviation of 93.22. The lowest mean calculated for this variable

was 189.09 minutes (standard deviation - 113.12) for the control group. It should be pointed out that the filmstrip method achieved the highest mean score on the identification posttest with a mean of 329.54 and the control group the lowest, with a mean score of 173.52.

In order to determine if differences occurred between the mean times reported for the groups sampled, an analysis of variance was calculated for the amount of time students spent learning plant names (Table 34).

Table 34. Analysis of variance of time spent in learning plant names by groups

Source of variation	d.f.	S.S.	M.S.	F-value
Regression	3	20427.24	6809.08	1.60
Error	4	17041.84	4260.46	
Total	7	37469.08		

When this analysis was made, it was disclosed that there was no significant difference in the amount of time each group worked on its objective of learning the common names of fifty ornamental plants. The result of this analysis was an F-value of 1.60 with three and four degrees of freedom which was not significant.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Research was conducted to determine the effectiveness of selected teaching techniques that could be adapted to ornamental horticulture in teaching specific competencies to secondary students. More specifically, these objectives were:

1. To determine the effectiveness of instructional media in teaching the common names of ornamental plants as measured by student achievement.
2. To determine those factors which are related to achievement in ornamental horticulture when instructional media are used.
3. To determine the implications for the use of instructional media in horticulture programs.

The review of literature conducted to initiate this study indicated that one of the primary competencies that should be possessed by workers in horticultural occupations was the ability to recognize and identify plant material. It soon became obvious that most secondary schools in Iowa that were providing instruction in horticulture did not have the means to teach this competency to their students or as yet had not come to grips with this problem.

Numerous studies were implemented to measure the effectiveness of media oriented instruction in various subject matter areas and at various grade levels. It soon became apparent that no one technique was best suited for all teaching situations or clientele receiving instruction.

In many cases, studies reported that their treatment subjects were unable to achieve any higher than their counterparts in the control group.

In order to determine if there was a feasible solution to the problem of teaching about ornamental plants without the added expense of a growing structure and manpower for plant maintenance, eight secondary schools in Iowa were selected and assigned a treatment with their primary objective being to teach the students in their horticulture class the common names of fifty ornamental plants. These treatments consisted of audio-tutorial instruction, filmstrip and script, greenhouse facility and lecture-discussion (control).

The treatment period lasted for a duration of two weeks, during which a pretest and posttest over general horticulture information and knowledge of plant names was administered. Along with student achievement measures, demographic data about students, schools, teachers and agriculture programs were also gathered.

When a descriptive analysis was conducted with demographic data gathered during the implementation of this study, it was found that a majority (56.8 percent) of the students enrolled in horticulture classes were female. Often these students were in a vocational agriculture related class for the first time, as the mean number of semesters of agriculture completed by the 125 students involved in this study was approximately 2.0, counting the current semester. A possible explanation for this factor is that, for the most part, vocational agriculture instructors surveyed did not consider the horticulture course as part of their regular vocational agriculture program.

When residence was considered, students enrolled in the horticulture courses were nearly equally divided between urban and rural with 60 students living in town and 59 students living on farms. A much smaller number resided in dwellings located on land parcels less than 10 acres.

A surprising 60.8 percent of the students surveyed indicated they planned to continue their education beyond high school at either a four-year college or university or at a two-year vocational-technical school. Of those students planning to continue their education beyond high school, 40.8 percent perceived they would receive some additional formal instruction in some type of horticulture area.

It was also found that of the total number of students participating in this study, 23.2 percent felt they would prefer an occupation related to horticulture. However, only 10.4 percent of all students surveyed reported that they are receiving some type of horticultural job experience while in high school.

The reason given most often by students for enrolling in the horticulture class was that it was an elective they had selected because of their interest in horticulture. This response was given by nearly 80 percent of the students polled.

In determining the background training of the instructor involved in teaching the horticulture classes, data were gathered concerning the number of quarter hour credits each instructor earned in horticulture. It was revealed that two instructors had 30 credits or more, while two had not received any formal instruction in horticulture prior to this study. The remaining four instructors had received an average of approximately

seven credits in horticulture. All eight instructors questioned felt strongly that they could use inservice education in technical areas of horticulture to supplement their present knowledge or update their previous training.

Through analyses of pretest data, it was revealed that all groups were equivalent on the basis of their background knowledge in horticulture and familiarity with names of ornamental plants. A t-test administered to the differences between pretest and posttest means disclosed that all treatment groups and control group gained significantly in their ability to correctly identify ornamental plants. This same preliminary analysis of written horticulture mean scores indicated that none of these techniques was successful in promoting higher achievement on the written horticulture posttest that measured students' knowledge of plant characteristics and horticultural terminology. However, when written posttest mean scores were adjusted through the use of analysis of covariance utilizing size of senior high school as a covariate, it was revealed that the written posttest mean scores for the three treatment groups were significantly higher than the control group mean at the .10 level of probability. It should be pointed out that this is the only situation in which scores on the written evaluation were significantly different among treatments and control.

In almost all cases when analysis of covariance or statistical comparisons were made, students in the treatment methods outperformed those students in the control group. However, there was no significant difference on the plant identification measure among the treatments used which were audio-tutorial, filmstrip and script and greenhouse facility.

Through the use of correlation analysis, it was determined that relationships existed between demographic variables and students' achievement on posttest criteria. Among these were semesters of biology completed, grades received in biology, time spent learning plant names, years teaching experience of the instructor, number of students enrolled in vocational agriculture, size of high school, dollar value invested in the horticulture program and number of credits earned in horticulture by the instructor. All of these variables had a high positive correlation with students' posttest performance.

Conclusions

The conclusions drawn from this study apply directly to those programs involved, but due to assumed representativeness of these eight horticulture classes to other horticulture programs in the state of Iowa, many of these conclusions will be applicable to present and future secondary school horticulture programs. In light of the findings contained within this study, the following statements were concluded:

1. The horticulture curriculum taught at the secondary school level was generally not considered vocationally oriented as instructors regarded these courses as separate from their regular vocational agriculture program and students were not involved in horticultural related supervised occupational experience programs.
2. Residence has little or no effect on who will enroll in a horticulture course as the number of urban and rural students were nearly equal.

3. For the most part, students expressed an interest in horticulture and a relatively high percentage (23.2 percent) of those students participating in this study indicated they would like to enter a horticultural related occupation if the opportunity were available.
4. The major topic areas taught in secondary school horticulture programs were turf, landscaping, small fruit production and vegetable production.
5. The two instructional units perceived to be the most important taught in ornamental floriculture were plant propagation and plant identification.
6. A relationship existed between the semesters of biology completed and students' posttest achievement. Therefore, those students completing a greater number of semesters of biology were able to score higher on posttest evaluation.
7. Grades received in biology were correlated with posttest measures. Thus, a relationship between these variables indicated that those students receiving higher grades in biology were also able to score higher on posttest criteria.
8. Students' scores on posttest evaluation were found to be correlated with teacher tenure. This relationship indicated that teachers with a greater number of years teaching experience were more apt to have students with higher posttest scores.
9. A relationship was found to exist between students' posttest scores and the dollar value invested in the horticulture program.

Consequently, programs with a higher investment tended to have students who achieved higher posttest scores.

10. A relationship existed between the number of credits in horticulture earned by the instructor and students' posttest achievement. Instructors with a higher number of credits, implying a stronger background in horticulture, were more apt to have students who scored higher on the posttest evaluation.
11. There was a relationship between the number of credits instructors had in horticulture and the dollar value of their horticulture program. Those instructors with a greater number of credits in the subject of horticulture had more money invested in their programs.
12. All methods used to teach students the names of ornamental plants were successful in achieving a significant gain score for their students in plant identification.
13. None of the methods used in this study were able to produce a significant gain in general horticulture knowledge when written test questions were used as the measuring criteria.
14. Students in treatment groups consisting of audio-tutorial, filmstrip and script and greenhouse facility performed significantly better than students in the control group consisting of the lecture-discussion method.
15. There was no significant difference in the plant identification posttest mean scores among the audio-tutorial, filmstrip and script and greenhouse facility groups. Therefore, common names

of ornamental plants can be taught as effectively using instructional media as they can be with the use of live plant specimens maintained in a greenhouse structure with which students have free access.

16. There was no significant difference in the amount of time students spent in learning plant names, thus, one method of instruction was not more efficient than another.

Recommendations

The following recommendations and implications for the horticulture programs in the state of Iowa are based on the conclusions and personal observations generated by this study.

1. Based on the result that media oriented instruction is able to fulfill the need for specific nonaccessible teaching material or experiences, instructors should be encouraged to develop their own media resources or be made aware of the availability of commercially prepared instructional aids.
2. Due to the relationship between student achievement, program development and number of credits obtained in horticulture, instructors who are deficient in training should be encouraged to seek supplemental instruction and training in technical horticulture.
3. Inservice education should be planned and implemented by qualified personnel in order to provide an avenue for teachers who desire to upgrade their present background in horticulture.

4. Assistance in direction of program planning and curriculum development should be available for established and newly emerging programs in horticulture at the secondary level.
5. In order to establish the vocational aspect of horticulture at the secondary level, students should be encouraged to develop a supervised occupational experience program centered around some aspect of horticulture.
6. Since one-half the students in various horticulture programs are rural residents, supervised occupational experience programs in production horticulture should be stressed in order for these students to take advantage of this opportunity.
7. Occupational information involving job opportunities in horticulture and other areas of agriculture need to be provided for the large number of students in these programs who are as yet undecided about their future occupational plans.
8. Due to the success of media in teaching the competency of plant material identification, these techniques need to be evaluated in their effectiveness of teaching other lab skills and competencies in horticulture or related fields.

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APPENDIX A: LIST OF FIFTY ORNAMENTAL PLANTS

ORNAMENTAL HORTICULTURE

PLANT LIST

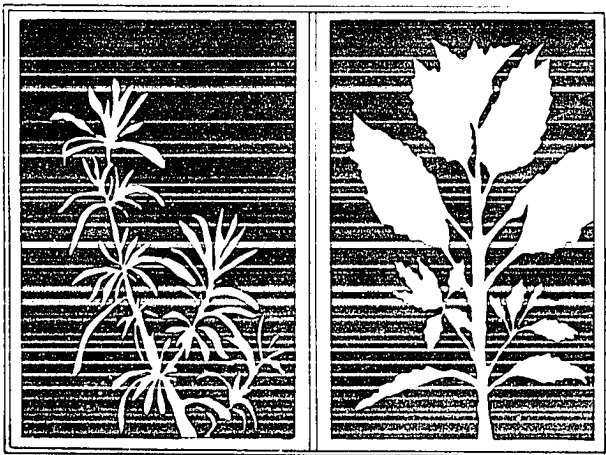
This list is composed of 50 common house plants or cut-flower specimens. You are to learn the common names of these plants to the best of your ability by the method described by your instructor. At the end of this instructional period, you will be tested over 25 plants randomly selected from this list by identifying the actual specimen.

<u>COMMON NAME</u>	<u>SCIENTIFIC NAME</u>
1. African Violet	Saintpaulia ionantha
2. Airplane Plant	Chlorophytum elatum
3. Aluminum Plant	Pilea cadieri
4. Arrowhead Vine	Syngonium podophyllum
5. Artillery Plant	Pilea microphylla
6. Asparagus Fern	Asparagus plumosus
7. Boston Fern	Nephrolepis exaltata bostoniensis
8. Caladium	Caladium bicolor
9. Carnation	Dianthus caryophyllus
10. Cast Iron Plant	Aspidistra elatior
11. Chinese Evergreen	Aglaonema simplex
12. Chrysanthemum	Chrysanthemum morifolium
13. Coleus	Coleus blumei
14. Croton	Codiaeum variegatum
15. Crown of Thorns	Euphorbia splendens
16. Devil's Ivy	Scindapsus aureus
17. Dragon Palm	Dracaena marginata
18. Dumb Cane	Dieffenbachia picta
19. Emerald Ripple	Peperomia caperata
20. English Ivy	Hedera helix
21. False Aralia	Dizygotheca elegantissima
22. Fire Fern	Oxalis hedysaroides rubra

<u>COMMON NAME</u>	<u>SCIENTIFIC NAME</u>
23. Geranium	<i>Pelargonium hortorum</i>
24. Gladiolus	<i>Gladiolus hybrida</i>
25. Gloxinia	<i>Sinningia speciosa</i>
26. Grape Ivy	<i>Cissus rhombifolia</i>
27. Impatiens Plant	<i>Impatiens sultanii</i>
28. Iron Cross Begonia	<i>Begonia masoniana</i>
29. Jade Plant	<i>Crassula argentea</i>
30. Kalanchoe	<i>Kalanchoe blossfeldiana</i>
31. Moses-in-the-Cradle	<i>Rhoeo discolor</i>
32. Mother-in-Law's Tongue	<i>Sansevieria trifasciata</i>
33. Neantha Bella Palm	<i>Chamaedorea elegans</i>
34. Norfolk Island Pine	<i>Araucaria excelsa</i>
35. Peperomia	<i>Peperomia obtusifolia</i>
36. Philodendron	<i>Philodendron oxycardium</i>
37. Prayer Plant	<i>Maranta leuconeura kerchoveana</i>
38. Rex Begonia	<i>Begonia rex</i>
39. Ribbon Plant	<i>Dracaena sanderiana</i>
40. Rose	<i>Rosa hybrida</i>
41. Rubber Plant	<i>Ficus elastica</i>
42. Snapdragon	<i>Antirrhinum majus</i>
43. Swedish Ivy	<i>Plectranthus australis</i>
44. Umbrella Tree	<i>Brassaia actinophylla</i>
45. Velvet Plant	<i>Gynura aurantiaca</i>
46. Vinca	<i>Vinca major</i>
47. Wandering Jew	<i>Zebrina pendula</i>
48. Watermelon Peperomia	<i>Peperomia sandersii</i>
49. Wax Begonia	<i>Begonia semperflorens</i>
50. Wax Plant	<i>Hoya carnosa</i>

APPENDIX B: STUDY GUIDE FOR AUDIO-TUTORIAL PROGRAM

FIFTY ORNAMENTAL HOUSEPLANTS



CREATED BY

Duane Raus

INTRODUCTION

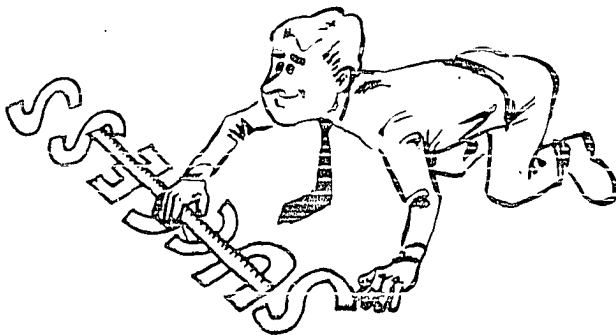
This study guide will aid you in the task of learning the common names of the 50 ornamental houseplants involved in this learning packet. A cassette tape, plant mounts, and slides are also included in this learning packet. Directions for using this study guide will be given in this booklet, as well as on the cassette tape. The questions posed on the tape and in this booklet will serve as a self-test as you progress in the self-instructional task of learning to correctly identify ornamental plants. You will be given an identification test over the plants on the list that is part of this learning packet.

OBJECTIVES

The underlying objectives of this learning packet on ornamental houseplants for you as a student are threefold. After completion of this instructional unit, you should be able to:

1. Recognize distinguishing characteristics of specific plants, such as their growth habit, leaf shape, leaf color, floral arrangement or color, or identifiable unique characteristics.
2. Answer correctly general questions about plant anatomy and horticultural terminology.
3. And lastly, identify at random, 25 of the 50 ornamental houseplants with near 100 per cent accuracy.

As you can see, all three of these objectives are tied closely together, with the third objective being your ultimate goal for this instructional unit. You should measure your level of success against how well you have achieved these three objectives.



PRETEST

You should have recently completed a pretest over 25 plants from the list of ornamental houseplants that is part of this learning packet. How did you do? If you did not do as well as you expected, do not despair, since it is the purpose of this learning packet to help you improve your ability to correctly identify ornamental plants. Learning plant names by this instructional method will be time well spent, as you should approach 100 percent accuracy on the upcoming posttest.

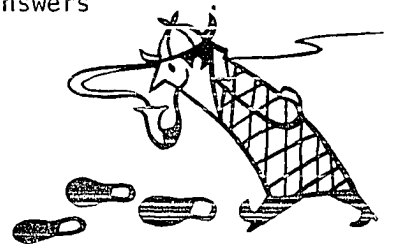


DIRECTIONS

To begin the first phase of your learning packet, place the accompanying cassette tape in a tape player and push the play button. Further directions will be given on the cassette tape.

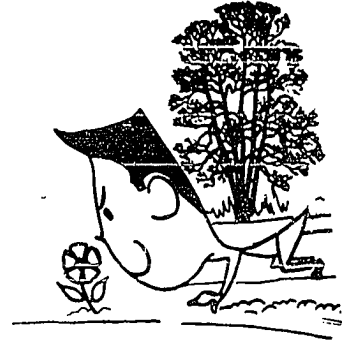
SELF-TEST

In finding the answers to the self-test questions, you will need to develop an understanding of plant characteristics and terms frequently used in the field of horticulture. The answers will be found on the cassette tape, in the slides of plants, and in the plant mounts designed for this packet. You will need to become somewhat of a detective, as you search out the clues given as you progress at your own speed through the learning packet. Suggested answers will be found on pages 11 and 12 of this booklet. Be sure to provide your own answers to the questions asked before you look at these pages. By comparing your answers to those provided, you will be able to evaluate your own progress in learning the common names of ornamental plants.




SELF-HELP TEST ONE

At this point, you should have viewed the slides and plant mounts for the first 25 plants. Self-Help Test One will ask questions about only the first 25 plants (African Violet to Gloxinia), and will consist of multiple-choice questions or questions where you will need to provide the answers. After you have answered all 15 questions, check your answers against those provided in the Key on page 11.



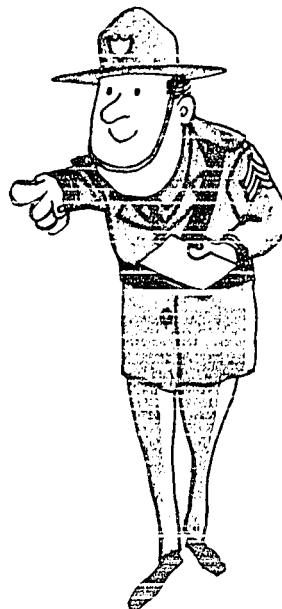
1. When considering the first 25 plants on your list, name three that have a vining growth habit.
 - a.
 - b.
 - c.
2. Which of these plants are grown as cut-flowers?
 - a.
 - b.
 - c.
3. Which of the first 25 plants have the smallest leaves, giving the foliage of these plants a fine texture or lacy appearance.
 - a.
 - b.
4. Identify those plants (1 - 25), that have colored or variegated foliage? Name as many as you can.

a.	e.
b.	f.
c.	g.
d.	

5. Of these plants, which has the tallest growth habit, enabling it to reach a height of 12 feet under optimum conditions?
 - a. Chinese Evergreen
 - b. Dragon Palm
 - c. False Aralia
6. Which plants on your list (1 - 25) are grown as flowering potted plants? Provide the names of these four.
 - a.
 - b.
 - c.
 - d.
7. Which plant can be distinguished by sharp thorns covering the plant stems?
 - a. Crown of Thorns
 - b. Devil's Ivy
 - c. Emerald Ripple
8. The plant that propagates itself by producing small plantlets on long, cascading stems is the:
 - a. Artillery Plant
 - b. Fire Fern
 - c. Airplane Plant
9. Identify the plant that has a hard root base and tough, resilient foliage which makes it a popular plant for public malls and airport terminals.
 - a.
10. This plant can be identified by its unique leaf-shape that has this appearance:  Which plant listed below had this characteristic leaf-shape?
 - a. Geranium
 - b. Arrowhead Vine
 - c. Chinese Evergreen

11. Which plant can be identified by its characteristic three-pointed leaves?
- a. Boston Fern
 - b. Dumb Cane
 - c. English Ivy
12. These two plants are related, by belonging to the same family, because both plants have soft, pubescent foliage.
- a. African Violet and Gloxinia
 - b. Gladiolus and Croton
 - c. Caladium and Chrysanthemum
13. This plant belongs to the Elephants-Ear group, but it has brightly colored foliage. Which plant is it?
- a. Coleus
 - b. Aluminum Plant
 - c. Caladium
14. Identify the plant that has ruffled or waffle-like foliage
- a.
15. The name of this plant indicates it has distinct, red foliage, although the plant is not a true member of this group. Write the name of this plant below.
- a.

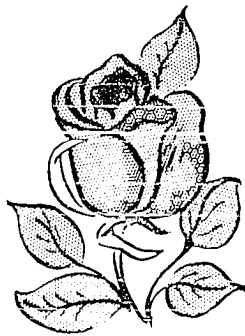
GO TO PAGE 6



RESTART THE TAPE

TURN TO PAGE 11 OF THIS STUDY GUIDE FOR THE CORRECT ANSWERS TO THE SELF-HELP TEST ONE. HOW DID YOU DO? DID YOU HAVE SOME DIFFICULTY IN SELECTING THE RIGHT ANSWER? IF YOU DID, GO BACK TO THE BEGINNING OF THIS TAPE, AND THE BEGINNING OF THE SLIDES. REVIEW THE MATERIAL OVER THE FIRST 25 PLANTS AND CORRECT THE WRONG ANSWERS ON YOUR SELF-HELP TEST ONE.


IF YOU HAD LITTLE DIFFICULTY IN ANSWERING THESE QUESTIONS CORRECTLY, RESTART THE SLIDE PROJECTOR AND BEGIN LEARNING THE SECOND SET OF 25 PLANTS. DO THIS AT YOUR OWN SPEED.



SELF-HELP TEST TWO

Self-Help Test Two will cover only the second 25 plants on your list (plants 26 - 50), so limit your answers to only these 25. Read each question carefully before answering, and answer all 15 questions before proceeding further in the study guide. Again, the questions will be either multiple-choice or questions where you will be asked to provide the answers.

1. Which of these plants (26 - 50 on your list) have a vining growth habit?
 - a.
 - b.
 - c.
 - d.
 - e.
 - f.
2. Which of these plants are grown as cut-flowers? Write your answers below.
 - a.
 - b.
3. Select the plant that has a whorled leaf arrangement where five leaflets radiate out from the same point.
 - a. Neantha Bella Palm
 - b. Mother-in-Law's Tongue
 - c. Umbrella Tree
4. Which group of plants have this general leaf-shape:

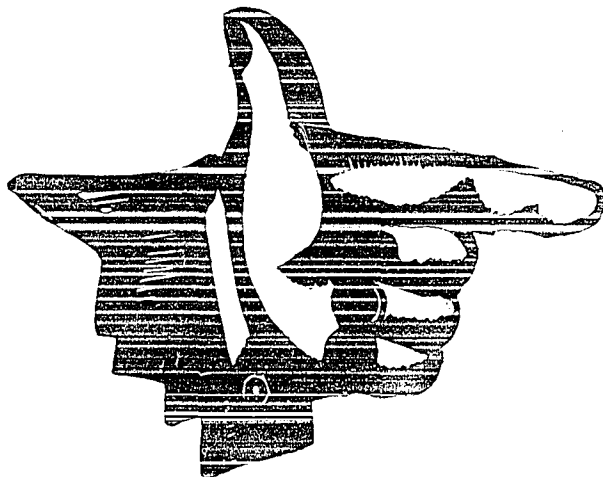

?

 - a.
5. This plant reacts to light by closing up its foliage at night and reopening during the day. Identify this plant.
 - a. Prayer Plant
 - b. Wax Begonia
 - c. Kalanchoe

6. Select from those listed below, the plant that has the appearance of a young corn plant with white stripes on its leaves.
 - a. Wandering Jew
 - b. Jade Plant
 - c. Ribbon Plant
7. Identify the plant that has oval-shaped leaves with light colored stripes, giving it the appearance of being a watermelon.
 - a.
8. Give the names of the two plants that have spine-like projections on their leaf margins.
 - a.
 - b.
9. Select the plant that has economical importance to the manufacturing industry.
 - a. Velvet Plant
 - b. Rubber Plant
 - d. Wax Plant
10. Which of the plants on your list (26 - 50) produce conspicuous flowers?
 - a.
 - b.
 - c.
 - d.
 - e.
 - f.
11. Circle the name of the plant below that has heart-shaped leaves?
 - a. Vinca
 - b. Swedish Ivy
 - c. Philodendron
12. Which of these plants will be the tallest when mature?
 - a. Neantha Bella Palm
 - b. Norfolk Island Pine
 - c. Impatiens Plant

13. Of the three plants listed below, which will have the most succulent foliage?
- a. Velvet Plant
 - b. Rose
 - c. Jade Plant
14. Identify the plants on your list (26 - 50), that have a purple coloring in their foliage.
- a.
 - b.
 - c.
15. Select the plants that are related in the following combinations. There is more than one combination that is related.
- a. Grape Ivy and Swedish Ivy
 - b. Peperomia and Watermelon Peperomia
 - c. Moses-in-the-Cradle and Mother-in-Law's Tongue
 - d. Velvet Plant and Wax Plant
 - e. Philodendron and Vinca
 - f. Wax Begonia and Iron Cross Begonia

GO TO PAGE 10



RESTART THE TAPE

TURN TO PAGE 12 OF YOUR STUDY GUIDE FOR THE CORRECT ANSWERS TO SELF-HELP TEST TWO. DID THESE QUESTIONS SEEM EASIER, SINCE YOU HAVE NOW DEVELOPED MORE OF AN AWARENESS ABOUT PLANT CHARACTERISTICS AND KNOW EACH PLANT IS UNIQUELY DIFFERENT?

IF YOU WERE STILL UNABLE TO ANSWER ALL OF THESE QUESTIONS CORRECTLY, GO BACK TO PLANT NO. 26 (GRAPE IVY), AND REVIEW THE LAST 25 PLANTS ONCE AGAIN.

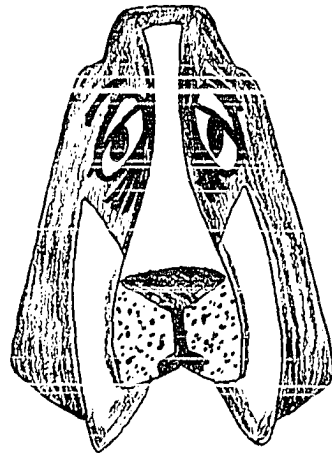
AFTER COMPLETION OF THIS PORTION OF THE STUDY GUIDE, YOU ARE NOW READY FOR THE IDENTIFICATION AND WRITTEN POSTTEST. YOU MAY FIND IT HELPFUL TO REVIEW ALL 50 PLANTS PRIOR TO YOUR POSTTEST IF TOO MUCH TIME ELAPSES BETWEEN THE COMPLETION OF THE INSTRUCTIONAL UNIT AND THE POSTTEST.

GOOD LUCK ON YOUR POSTTESTS AND A POSSIBLE CAREER AS A HORTICULTURIST.



KEY TO SELF-HELP TEST ONE

1. a. Arrowhead Vine
b. Devil's Ivy
c. English Ivy
2. a. Carnation
b. Chrysanthemum
c. Gladiolus
3. a. Artillery Plant
b. Asparagus Fern
4. a. Aluminum Plant
b. Caladium
c. Coleus
d. Croton
e. Devil's Ivy
f. Dumb Cane
g. Fire Fern
5. b. Dragon Palm
6. a. African Violet
b. Chrysanthemum
c. Geranium
d. Gloxinia
7. a. Crown of Thorns
8. c. Airplane Plant
9. a. Cast Iron Plant
10. b. Arrowhead Vine
11. c. English Ivy
12. a. African Violet and Gloxinia
13. c. Caladium
14. a. Emerald Ripple
15. a. Fire Fern



"AND I THOUGHT I HAD ALL
THE RIGHT ANSWERS."

KEY TO SELF-HELP TEST TWO

1. a. Grape Ivy
b. Philodendron
c. Swedish Ivy
d. Vinca
e. Wandering Jew
f. Wax Plant
2. a. Rose
b. Snapdragon
3. c. Umbrella Tree
4. a. The Begonias
5. a. Prayer Plant
6. c. Ribbon Plant
7. a. Watermelon Peperomia
8. a. Grape Ivy
b. Impatiens Plant
9. b. Rubber Plant
10. a. Impatiens Plant
b. Kalanchoe
c. Moses-in-the-Cradle
d. Rose
e. Snapdragon
f. Wax Begonia
11. c. Philodendron
12. b. Norfolk Island Pine
13. c. Jade Plant
14. a. Moses-in-the-Cradle
b. Velvet Plant
c. Wandering Jew
15. b. Peperomia and Watermelon Peperomia
f. Wax Begonia and Iron Cross Begonia



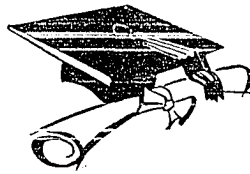
"THERE MUST BE
AN EASIER WAY."

POSTTEST

After you have completed the two Self-Help Tests included in this study guide and sufficiently reviewed the audio tape, slides and plant mounts, you are now ready to take the identification and written posttests.

The identification posttest will consist of 25 plants selected from your study list. The method in which it will be administered will be identical to your pretest.

The written posttest will be composed of 25 multiple-choice questions about information covered in the learning package you have just completed. The questions will deal with horticultural terms, plant anatomy, and specific plants you have studied.



CONGRATULATIONS! YOU HAVE LEARNED 50 ORNAMENTAL HOUSEPLANTS. YOU ARE NOW A GRADUATE OF THE A-T SCHOOL OF PLANT LEARNING.

HORTICULTURAL TERMS YOU SHOULD KNOW

HANGING BASKET - a planter arrangement where the growing container is suspended from above and allowed to hang free. Plants with a vining or cascading growth habit are often used in hanging baskets.

LEAF APEX -

LEAF BASE -

LEAF MARGIN -

LEAF MIDRIB -

PETIOLE -

PUBESCENT -

SERRATED -

SUCCULENT -

VARIEGATED - multi-colored, having different colors in spots or streaks on a solid background color. Varied coloration.

NOTES

APPENDIX C: WRITTEN PRETEST

ORNAMENTAL HORTICULTURE WRITTEN PRETEST

The following questions will test your general knowledge about ornamental horticulture. Read the instructions and all questions carefully before answering. An answer sheet will be provided for you to mark your appropriate answers. Use only a No. 2 lead pencil in marking your answers. You should have answered 50 questions when you have completed the test items. If you have any further questions, please ask your instructor or test monitor.

1. In the nursery industry, B&B refers to plants that are:
 - a. big and bushy
 - b. balled and burlapped
 - c. bare rooted
 - d. bruised and broken
2. An example of a plant that would be produced by a bulb would be:
 - a. Tulip
 - b. Croton
 - c. Rex Begonia
 - d. Chrysanthemum
3. A disease that commonly attacks young seedlings causing them to fall over and die is:
 - a. aphids
 - b. fusarium wilt
 - c. powdery mildew
 - d. damping-off
4. In order for a flower to be considered perfect, it must have which flower parts?
 - a. petals and sepals
 - b. pistils and stamens
 - c. petals and a calyx
 - d. receptacle and an ovary
5. The plant most often associated with the Christmas Season is the:
 - a. Poinsettia
 - b. Prayer Plant
 - c. African Violet
 - d. Chrysanthemum

6. An example of a vining plant is:

- a. Gloxinia
- b. Coleus
- c. Dieffenbachia
- d. Philodendron

7. An example of an upright growing plant is:

- a. Devil's Ivy
- b. Geranium
- c. English Ivy
- d. Wandering Jew

8. A plant that requires two years to grow from seed and bloom before dying the second year is called a/an:

- a. annual
- b. evergreen
- c. perennial
- d. biennial

9. The removal of a leaf section, plant stem, or portion of root for the purpose of propagation is referred to as:

- a. a cutting
- b. grafting
- c. pruning
- d. layering

10. A plant that drops its leaves during the winter season is called a/an _____ plant.

- a. evergreen
- b. broadleaf
- c. non-ornamental
- d. deciduous

11. The result of crossing two inbred lines of a plant is a:

- a. clone
- b. chimera
- c. hybrid
- d. mutation

12. The part of the leaf which attaches the leaf blade to the plant is called the:

- a. pedicel
- b. raceme
- c. filament
- d. petiole

13. The part of the flower that is the male portion is the:
- stamen
 - pistil
 - petal
 - sepal
14. The process of _____ involves the removal of soft growth tips by twisting them out with thumb and forefinger.
- dwarfing
 - flower sterilization
 - plant breeding
 - pinching
15. Foliage that contains one or more colors besides green: such as white, is considered:
- diseased
 - variegated
 - albino
 - chlorotic
16. In seed germination, the first process or step a seed undergoes is:
- water absorption
 - production of enzymes
 - break down of stored food
 - cell elongation
17. In making a graft, the _____ is grafted onto the root stock.
- rhizome
 - plant leaf
 - scion
 - stolon
18. Intracellular means:
- between cells
 - within a cell
 - adjacent to a cell
 - in contact with a cell
19. Of the following rooting media, _____ is the heaviest.
- sphagnum moss
 - vermiculite
 - perlite
 - sand

20. Of the following rooting media, _____ is the one that is organic in nature.
- a. sand
 - b. perlite
 - c. sphagnum moss
 - d. vermiculite
21. The Mint Family of plants is characterized by having square stems. Which one of the following plants will be found in the Mint Family?
- a. Coleus
 - b. English Ivy
 - c. Chrysanthemum
 - d. Gloxinia
22. Which one of the following plants has a spike inflorescence?
- a. African Violet
 - b. Chrysanthemum
 - c. Carnation
 - d. Snapdragon
23. Which one of the following is not a true fern?
- a. Bird's-nest Fern
 - b. Asparagus Fern
 - c. Boston Fern
 - d. Staghorn Fern
24. Which one of the following is not a pine tree?
- a. Norfolk Island Pine
 - b. White Pine
 - c. Red Pine
 - d. Scotch Pine
25. When leaves have a toothed edge, instead of being smooth, they are said to be:
- a. oblong
 - b. serrated
 - c. entire
 - d. spiny
26. An important product of photosynthesis for humans is:
- a. chlorophyll
 - b. oxygen
 - c. light
 - d. water

27. The most popular cut-flower in terms of numbers purchased by consumers is the:
- a. Carnation
 - b. Rose
 - c. Snapdragon
 - d. Orchid
28. The leaf _____ is the portion of the leaf that is furthest from the point of leaf attachment.
- a. base
 - b. vein
 - c. apex
 - d. margin
29. A leaf arrangement that has two leaves attached at the same node across from one another is referred to as:
- a. alternate arrangement
 - b. parallel arrangement
 - c. opposite arrangement
 - d. whorled arrangement
30. The leaf _____ is that portion of the leaf nearest to the point of leaf attachment.
- a. apex
 - b. margin
 - c. base
 - d. tip
31. A complete plant fertilizer will contain at least these three nutrients:
- a. nitrogen, phosphorus, and potassium
 - b. boron, nitrogen, and magnesium
 - c. nitrogen, zinc, and potassium
 - d. iron, phosphorus, and calcium
32. A leaf structure consisting of a single leaf and a single petiole, is called a _____ leaf.
- a. compound
 - b. simple
 - c. sessile
 - d. palmate
33. A plant that exhibits an acute-shaped (narrow angle) leaf tip is the:
- a. Airplane Plant
 - b. Peperomia
 - c. African Violet
 - d. Jade Plant

34. Which of the following is not a form of asexual reproduction of a plant?
- a. cutting
 - b. layering
 - c. grafting
 - d. seed propagation
35. Before potting soil is used, it is heated with steam or in an oven in order to:
- a. prevent cold shock to plant roots
 - b. increase its water holding capacity
 - c. kill plant disease organisms
 - d. remove unwanted soil minerals
36. The process by which plants lose water in order to cool leaf surfaces is called:
- a. transpiration
 - b. perspiration
 - c. respiration
 - d. oxidation
37. A herbicide is a chemical substance that kills:
- a. insects
 - b. plants
 - c. fungus organisms
 - d. bacteria
38. A soil borne pest that attacks plant roots, yet is so small you cannot see them without the aid of a microscope, is the:
- a. aphid
 - b. white fly
 - c. spider mite
 - d. nematode
39. A short-day plant is one that requires a light period of 10-12 hours in order to:
- a. undergo photosynthesis
 - b. change color
 - c. flower
 - d. develop leaf buds
40. Overwatering is harmful to plants because:
- a. excess water leaches out plant nutrients
 - b. water causes a large drop in soil temperature
 - c. water contains many harmful mineral deposits
 - d. excess water replaces oxygen in the soil

41. A plant's vascular system is composed of:
- a. parenchyma tissue
 - b. epidermal tissue
 - c. phloem and xylem tissue
 - d. meristematic tissue
42. The green pigment found in plant tissue is called:
- a. corolla
 - b. pollen
 - c. carotene
 - d. chlorophyll
43. Respiration is a process where plants take up oxygen and give off carbon dioxide, and this process occurs:
- a. only in the dark
 - b. in all living cells all the time
 - c. only in the light
 - d. only during the growing season
44. Terrarium plantings are those that are grown:
- a. in your garden
 - b. outside in a landscape design to enhance the home
 - c. in large planters inside a public building
 - d. in a glass container
45. In the commercial greenhouse, plants are grown either as potted plants or cut-flowers. Which one of the following is not a cut-flower?
- a. Rose
 - b. African Violet
 - c. Carnation
 - d. Snapdragon
46. Several kinds of material are used as the "skin" or outside covering of a greenhouse. Of the following, which one would not be suitable for this covering?
- a. glass
 - b. clear plastic film
 - c. fiberglass
 - d. aluminum siding
47. In order for seeds to germinate, certain environmental conditions must be met. Which of the following is not necessary for seed germination?
- a. presence of oxygen
 - b. favorable temperature (60°F to 80°F)
 - c. presence of plant nutrients
 - d. presence of water

48. When a plant has succulent leaves, it means these leaves are:
- a. thick and fleshy
 - b. covered with a wax coating
 - c. attached directly to the plant stem
 - d. some color other than green
49. MagAmp and Osmocote are two examples of:
- a. automatic watering systems
 - b. insecticides
 - c. plant diseases
 - d. slow release fertilizers
50. The major problem of producing Easter Lilies is that:
- a. bulbs for growing them are not produced in this country
 - b. there is no market for them after Easter Sunday
 - c. they are vulnerable to many diseases and insects
 - d. there is only one variety of this plant on the market

APPENDIX D: WRITTEN POSTTEST

ORNAMENTAL HORTICULTURE WRITTEN POSTTEST

The following questions will test your knowledge about information you have gained while learning the names of ornamental plants. These questions will deal with horticulture terminology, plant anatomy, and characteristics of specific plants you have studied. Read the instructions and all questions carefully before answering. An answer sheet will be provided for you to mark your appropriate answers. Use only a No. 2 lead pencil in marking your answers. You should have answered 25 questions when you have completed the test items. If you have any further questions, please ask your instructor or test monitor.

1. The overall appearance that a plant exhibits as to whether it's tall, short and bushy, or vining, is referred to as its:
 - a. physique
 - b. growth habit
 - c. environmental response
 - d. growth potential
2. The term pubescent, refers to plants that are:
 - a. tall and willowy
 - b. propagated from cuttings
 - c. grown indoors as well as outdoors
 - d. covered with soft hairs
3. An example of a true fern is the:
 - a. Asparagus Fern
 - b. Fire Fern
 - c. Jade Fern
 - d. Boston Fern
4. A plant that has variegated foliage is the:
 - a. Kalanchoe
 - b. Emerald Ripple
 - c. Croton
 - d. Umbrella Tree

5. The plant that is grown both as a flowering potted plant and a cut-flower specimen is the:
 - a. Chrysanthemum
 - b. Snapdragon
 - c. Geranium
 - d. African Violet
6. The plant that can be identified by its characteristic three-pointed leaves is the:
 - a. Swedish Ivy
 - b. Rex Begonia
 - c. Impatiens Plant
 - d. English Ivy
7. The leaf _____ attaches the leaf blade to the plant stem.
 - a. receptacle
 - b. petiole
 - c. apex
 - d. pedicel
8. Succulent foliage is thick and fleshy in appearance. Of the following plants, which one has the most succulent foliage?
 - a. Jade Plant
 - b. Velvet Plant
 - c. False Aralia
 - d. Aluminum Plant
9. An example of a vining plant is the:
 - a. Ribbon Plant
 - b. Grape Ivy
 - c. Cast Iron Plant
 - d. Coleus
10. A plant that has distinctly serrated leaf margins is the:
 - a. Peperomia
 - b. Vinca
 - c. Gloxinia
 - d. False Aralia
11. The Mint Family of plants is characterized by having square stems. Which one of the following plants will be found in the Mint Family?
 - a. Swedish Ivy
 - b. Iron Cross Begonia
 - c. Rubber Plant
 - d. Artillery Plant

12. A plant that can be identified by its heart-shaped leaves and vining growth habit is the:
 - a. Swedish Ivy
 - b. Wandering Jew
 - c. Grape Ivy
 - d. Philodendron
13. When a plant is described as having serrated leaves, it means these leaves:
 - a. are covered with fine hairs
 - b. have a smooth leaf margin
 - c. have saw-like notches along the edge
 - d. are comprised of more than one color
14. A plant that can be recognized because of purple colored hairs covering the leaves and stems is the:
 - a. Moses-in-the-Cradle
 - b. Velvet Plant
 - c. Aluminum Plant
 - d. Caladium
15. Which of these plants will exhibit a spike inflorescence?
 - a. Kalanchoe
 - b. Chrysanthemum
 - c. Carnation
 - d. Gladiolus
16. One of the identifying characteristics of this plant is the presence of thorns. Which plant can be identified by this characteristic?
 - a. Snapdragon
 - b. Cast Iron Plant
 - c. Rose
 - d. Arrowhead Vine
17. Which of these plants listed below is not a pine tree?
 - a. Red Pine
 - b. Norfolk Island Pine
 - c. Black Pine
 - d. White Pine
18. When considering those plants listed below, which one is grown as a cut-flower?
 - a. African Violet
 - b. Gloxinia
 - c. Snapdragon
 - d. Geranium

19. The portion of the leaf furthest from point of leaf attachment to the stem is the:
- a. leaf midrib
 - b. leaf base
 - c. leaf apex
 - d. leaf margin
20. This plant can be identified by the glossy appearance of its leaves and flowers. Which plant is being described?
- a. Iron Cross Begonia
 - b. Dragon Palm
 - c. Wax Plant
 - d. Dumb Cane
21. A plant that is composed of stiff, upright growing leaves is the:
- a. Devil's Ivy
 - b. Mother-in-Law's Tongue
 - c. Watermelon Peperomia
 - d. Ribbon Plant
22. Which plant reacts to absence of light by folding up its leaves?
- a. Prayer Plant
 - b. Impatiens Plant
 - c. Airplane Plant
 - d. Neanthe Bella Palm
23. Which of the following plants would be the most suitable for a hanging basket?
- a. False Aralia
 - b. Wandering Jew
 - c. Rubber Plant
 - d. Wax Begonia
24. The plant juice secreted by this plant can cause temporary paralysis of the tongue if ingested. Which plant is being described?
- a. Emerald Ripple
 - b. Peperomia
 - c. Rex Begonia
 - d. Dumb Cane
25. The most recognizable characteristic of this plant is its multi-colored foliage. Which of the plants listed below can be identified by this characteristic?
- a. Crown of Thorns
 - b. Philodendron
 - c. Coleus
 - d. Grape Ivy

APPENDIX E: PLANT IDENTIFICATION PRETEST AND POSTTEST

PLANT IDENTIFICATION

PRE- AND POSTTEST

NAME _____

159

SCHOOL _____

To complete the identification test, place the number of the plant specimen across from the common name of the plant you feel matches this number.

COMMON NAME	NUMBER	SCORE
African Violet		
Airplane Plant		
Aluminum Plant		
Arrowhead Vine		
Artillery Plant		
Asparagus Fern		
Boston Fern		
Caladium		
Carnation		
Cast Iron Plant		
Chinese Evergreen		
Chrysanthemum		
Coleus		
Croton		
Crown of Thorns		
Devil's Ivy		
Dragon Palm		
Dumb Cane		
Emerald Ripple		
English Ivy		
False Aralia		
Fire Fern		

COMMON NAME	NUMBER	SCORE
Geranium		
Gladiolus		
Gloxinia		
Grape Ivy		
Impatiens Plant		
Iron Cross Begonia		
Jade Plant		
Kalanchoe		
Moses-in-the-Cradle		
Mother-in-Law's Tongue		
Neantha Bella Palm		
Norfolk Island Pine		
Peperomia		
Philodendron		
Prayer Plant		
Rex Begonia		
Ribbon Plant		
Rose		
Rubber Plant		
Snapdragon		
Swedish Ivy		
Umbrella Tree		
Velvet Plant		
Vinca		
Wandering Jew		
Watermelon Peperomia		
Wax Begonia		
Wax Plant		

APPENDIX F: STUDENT SURVEY

ORNAMENTAL HORTICULTURE QUESTIONNAIRE

NAME _____

SCHOOL _____

CIRCLE ONE

1. What is your present grade level?

FRESHMAN
 SOPHOMORE
 JUNIOR
 SENIOR

MALE
 FEMALE
2. How many semesters of Vocational Agriculture have you completed counting this semester?

1 2 3 4 5 6 7 8
3. What is the average grade you have received in all of your Vocational Agriculture work to date?

A B C D F

None Received
4. How many semesters of Biology or Botany have you completed counting this semester?

1 2 3 4
5. What is the average grade you received in your Biology or Botany course work to date?

A B C D F

None Received
6. What classification of residence most closely describes the location of your home?

TOWN

ACERAGE (less than 10 acres)

FARM (more than 10 acres)
7. Are you employed in a horticultural related work experience program or work part-time in a horticultural related occupation?

YES NO
8. Upon graduation from high school, which selection most closely approximates your future goals?

Attend a 4-year college

Attend a 2-year technical school

Find immediate employment
9. If in number eight you plan to continue your education beyond high school, will you take additional courses in horticulture or a horticultural related subject?

YES NO

CIRCLE ONE

10. Upon completion of your formal education, whether it be high school, vocational-technical school or a four-year college or university, which occupational area most accurately describes your job preference?

Horticultural Occupation

Nonhorticultural Occupation

Undecided

11. Were you a member of this year's or last year's State FFA Horticulture Contest team?

YES NO

12. Which selection best describes your reason for enrolling in this class?

It is an elective I selected because of my interest in horticulture

It is part of my regular Vocational Agriculture class

I have little or no interest in this area, but it was the only class available

13. How many hours did you spend learning the names of the 50 plants in this horticulture course? (Count the time you spent in class and outside of class)

0 1 2 3 4 5 6 7 8 9

APPENDIX G: INSTRUCTOR AND PROGRAM SURVEY

PROGRAM AND TEACHER INVENTORY
FOR
VOCATIONAL AGRICULTURE

The following data items will be used for purposes of analysis only, and are not intended as a means of program evaluation. Because of its analytical implications, your accurate responses are necessary and much appreciated.

NAME _____ SCHOOL _____

1. What is the total number of years you have been teaching Vocational Agriculture? _____
2. How many years have you been teaching Vocational Agriculture in your present school system? _____
3. How many students are enrolled in the horticulture class involved in this study? _____
4. How many students are enrolled in your total Vocational Agriculture program? _____
5. What is the approximate number of students enrolled in the high school (grades 9-12) at which you teach? _____
6. In terms of semesters, how much horticulture do you teach in your total vocational program? _____ semesters
7. Are your horticulture courses a part of your total vo-ag program and included as part of Agriculture I, or Agriculture II, etc., or are they a separate course offering?
 _____ part of regular vo-ag program
 _____ separate course offering
8. What is the assessed dollar value of your horticulture equipment, tools, plant material, text books, greenhouse structure, etc.? \$ _____
9. In assessing your background training in horticulture, how many quarter hour credits have you completed in horticulture at a 4-year institution? _____ credits
10. Would you be interested in receiving inservice education involving various areas of horticulture if it were available? YES NO

11. What other areas of horticulture do you teach besides ornamental floriculture? (Check those taught)

☐ Landscape Establishment and Maintenance
☐ Nursery Production
☐ Turf Establishment and Maintenance
☐ Arboriculture
☐ Tree Fruit Production
☐ Small Fruit Production
☐ Vegetable Production
☐ Other (specify) _____

12. Which of the following units do you cover in your ornamental floriculture course and what is the approximate length taught in terms of weeks? (Check those units you teach and list length of time taught in terms of weeks)

UNIT	LENGTH (WEEKS)
<input type="checkbox"/> Occupational Opportunities in Ornamental Horticulture	_____
<input type="checkbox"/> Ornamental Horticulture Salesmanship and Selling	_____
<input type="checkbox"/> Employability Skills and Human Relations	_____
<input type="checkbox"/> Hand and Power Tools and Hardware Used In Ornamental Horticulture	_____
<input type="checkbox"/> Planting Media and Its Preparation	_____
<input type="checkbox"/> Greenhouse Plant Propagation	_____
<input type="checkbox"/> Fertilization of Floral Plants	_____
<input type="checkbox"/> Maintaining Desirable Environmental Conditions in the Greenhouse	_____
<input type="checkbox"/> Insect and Disease Control in the Greenhouse	_____
<input type="checkbox"/> Operation and Care of Small Gasoline Engines	_____
<input type="checkbox"/> Arranging and Designing with Flowers, Plants, and Decorative Materials	_____
<input type="checkbox"/> Identification and Selection of Plant Material	_____